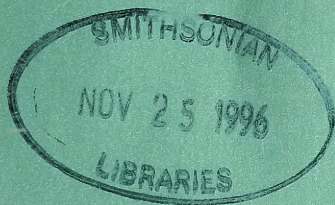


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ANNALES

de la
SOCIÉTÉ SUISSE DE ZOOLOGIE
et du
MUSÉUM D'HISTOIRE NATURELLE
de Genève

tome 103
fascicule 3
1996



REVUE SUISSE DE ZOOLOGIE

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TOME 103 — FASCICULE 3

Publication subventionnée par l'Académie suisse des Sciences naturelles
et la Société suisse de Zoologie

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Three new species of *Carniella* from Thailand (Araneae, Theridiidae)

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Three new species of *Carniella* from Thailand (Araneae, Theridiidae). -

Three new species from montane forests in Thailand are tentatively described in *Carniella*, hitherto known only from Europe: *C. siam* n. sp. (♂ ♀), *C. schwendingeri* n. sp. (♂) and *C. orites* n. sp. (♀). Habitat and relationships are discussed. The following new combinations, all from *Theonoe* (Theridiidae), are proposed: *C. globifera* (Simon, 1899), Sumatra; *C. weyersi* (Brignoli, 1979), Sumatra; *C. detriticola* (Miller, 1970), Angola. For comparison, the ♀ epigyne/vulva of *C. weyersi* is illustrated.

Key-words: Araneae - Theridiidae - Taxonomy - *Carniella* - *Theonoe* - Thailand.

INTRODUCTION

The enigmatic genus *Carniella*, recently described in Theridiidae by THALER & STEINBERGER (1988), was known hitherto only from mid Europe by 5 males collected in Austria, Bavaria (DRÖSCHMEISTER 1994) and Belgium (BAERT & VAN KEER 1991), belonging to the type species *C. brignolii*. The female of *C. brignolii* is still unknown, and its habitat and distribution are not yet clear. However, the genus *Carniella* seems to be represented by numerous species in SE-Asia. There exist clearly related species, as has already been indicated by WUNDERLICH (1994). Three further *Carniella* species collected by P. Schwendinger in Thailand are described in this paper.

ABBREVIATIONS

E embolus, f tegular fold, Pc paracymbium, S subtegulum, T tegulum, TA tegular apophysis. - CTh Thaler collection. MHNG Muséum d'histoire naturelle, Genève. MHNP Muséum d'Histoire naturelle, Paris.

Carniella siam n. sp.

(Figs 1, 4–6, 9–15, 21, 22)

Material examined: Holotype: ♂ (MHNG), Doi Ankhong 1500 m, 30.10.1987. Paratypes: 1 ♂ (CTh), 1 ♀ (MHNG), Doi Ankhong 1500 m, 30.10.1987. 1 ♀ (MHNG), Huay Nam Dang 1400 m, 17.12.1990. 1 ♂ (MHNG), Doi Inthanon 1780 m, 3.3.1987. 1 ♂ (CTh), Doi Inthanon 1020 m, 17.2.1987. 1 ♀ (CTh), Doi Suthep 1150 m, 14.2.1987. All specimens leg. P. Schwendinger in Chiang Mai Province, N-Thailand.

Diagnosis: ♂ clypeus modified (Figs 1, 5, 6). *C. siam* can be recognised by genital characters only, embolus (♂) (Figs 13–15), epigyne/vulva (♀) (Figs 21, 22).

Description: ♂: Measurements (mm): carapace 0.57 long, 0.46 wide. Length of abdomen 0.59, sternum 0.34 long.

Colour: Carapace brown with dark seam at its margins and a median greyish marking. Sternum and legs brown, trochanters and patellae light brown. Abdomen dark grey, epigaster grey brown.

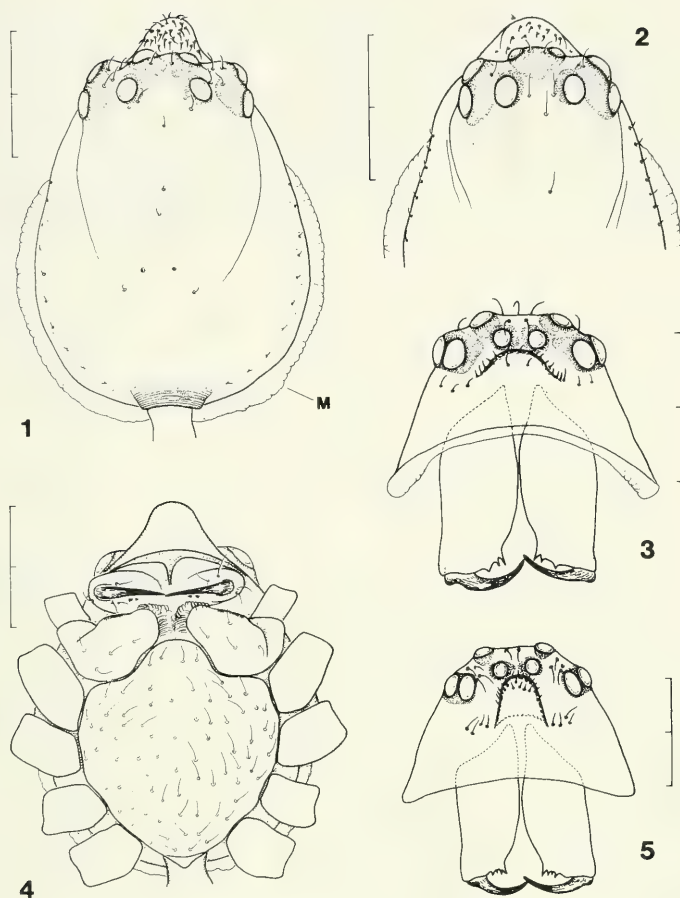
Clypeal projection of carapace conspicuous (Figs 1, 5, 6), covered with short hairs. Sides of carapace with bulging membrane (M, Fig. 1). Chelicerae: Basal extension typically theridiid, anterior margin of fang groove with 3 teeth, posterior margin with 2 teeth. Sternum pointed behind (Fig. 4). Labium fused with sternum, not rebordered. Stridulatory organ present, not divided in midline (Fig. 1). Abdomen weakly sclerotised around pedicel, with dorsal circle of warty hairs (stridulatory warts). Colulus large, 2 setae present.

Leg measurements (mm):

	Fe	Pa	Ti	Mt	Ta	Total
Palp	0.22	0.12	0.08	—	0.25	0.67
I	0.37	0.14	0.30	0.22	0.26	1.30
II	0.35	0.14	0.24	0.18	0.24	1.14
III	0.28	0.11	0.20	0.15	0.22	0.96
IV	0.38	0.14	0.31	0.19	0.25	1.26

Legs: 1423. Trichobothrial pattern (numbers of prodorsal/retrodorsal trichobothria of tibiae) of legs I, II, IV identical in all specimens [$n = 5$]: I–II 1/2, IV 2/2, their position on I 0.18/0.11;0.31, on IV 0.11;0.27/0.29;0.56. Pattern of tibia III apparently somewhat variable: 1/2 [$n = 3$], 2/1 [$n = 1$], 2/2 [$n = 1$]. Metatarsi I–II with 1 trichobothrium (0.34). Distal metatarsi ventrally with few weak serrate bristles. Tarsal organ I–IV (0.26–0.34). Tarsi I–IV 1.2–1.5 times longer than metatarsi. Tarsi I–IV ventrally with 2 rows of 6–7 serrate bristles, as in ♀, Fig. 12. Tarsal claws with ca. 3 minute teeth.

♂ Palp: Figs 11, 13–15. Tibia cone-shaped, without trichobothrium. Tarsus not twisted. Cymbium in dorsal position, slender, distally modified, its tip presumably supporting the embolus. Paracymbium hook-like, arising proximally from the retrolateral margin of the cymbium. Subtegulum prolateral-dorsal, with large hematodocha. Tegulum prolateral-dorsal (Fig. 11), with one dorsal tegular apophysis, which is partly hidden by the cymbium. Conductor absent. Tegular apophysis with



FIGS 1-5

Carniella siam n. sp., male (1, 4, 5, Doi Inthanon). *C. schwendingeri* n. sp., male (2, 3). Carapace, dorsal (1, 2), ventral (4) and frontal view (3, 5). Scale lines 0.2 mm.

loop of the sperm duct (Fig. 11), lamellate at its anterior border, its retrolateral end with concavity which presumably is anchored to the paracymbium when expanded. The embolus is the most striking character for its dark sclerotisation, distal part slender and slightly curved, with short accessory spur. Embolar base evenly narrow. The constricted part of the sperm duct crosses the tegulum and enters the tegular apophysis prolaterally, where it makes a loop, then curves retrolaterally into the embolar base.

♀: Measurements (mm): carapace 0.48 long, 0.42 wide. Length of abdomen 0.64.

Colour: similar to male.

Carapace not modified, stridulatory ridges reduced. Sternum and labium as in male. Chelicerae (Fig. 10): anterior margin of fang groove with 3 teeth, posterior margin with 2. Spinnerets (Fig. 9): Colulus large, 2 setae present. Posterior lateral spinnerets with two modified spigots, but not widened and therefore not typically theridiid.

Leg measurements (mm):

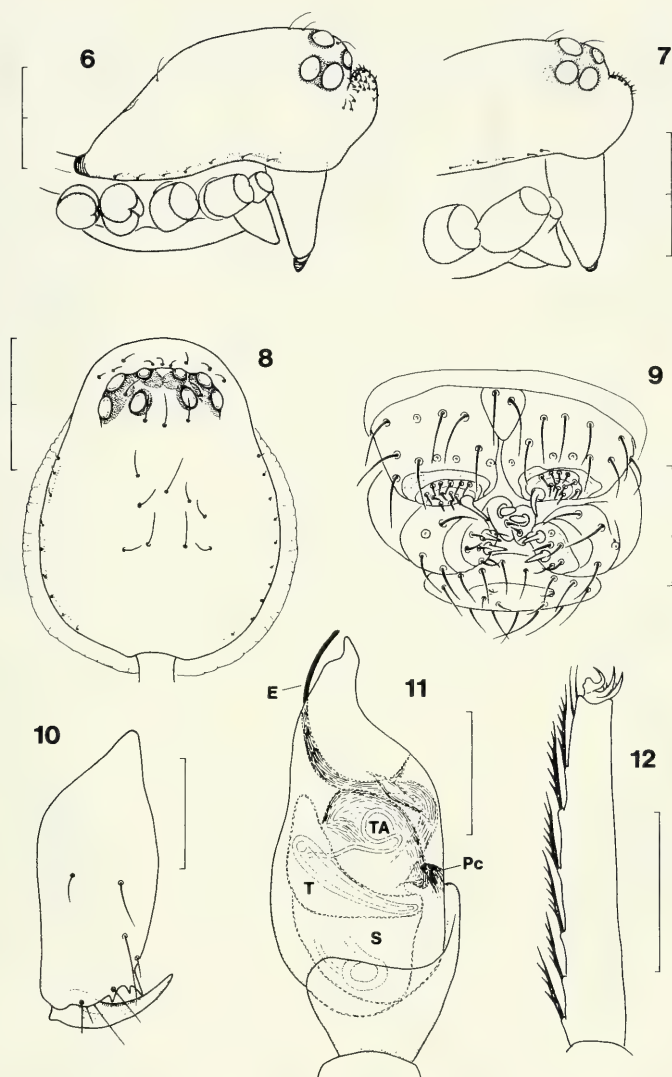
	Fe	Pa	Ti	Mt	Ta	Total
Palp	0.14	0.07	0.10	—	0.15	0.46
I	0.30	0.14	0.24	0.16	0.22	1.05
II	0.28	0.14	0.22	0.14	0.22	0.99
III	0.25	0.12	0.16	0.12	0.20	0.84
IV	0.31	0.14	0.27	0.16	0.22	1.10

Legs: 4123. Numbers of prodorsal/retrodorsal trichobothria of tibiae I 1/2, II 1/2, IV 2/2 identical in all specimens [$n = 3$], as in male, their position on I 0.16/0.13;0.34, on IV 0.13;0.33/0.37;0.63. Pattern of tibia III again variable: 1/2 [$n = 1$], 2/2 [$n = 2$]. Metatarsi I–II with 1 trichobothrium (0.40; 0.38). Distal metatarsi ventrally with few weak serrate bristles. Tarsal organ I–IV (0.26–0.31). Tarsi I–IV 1.4–1.7 times longer than metatarsi. Tarsi I–IV ventrally with 2 rows of 6–7 serrate bristles (Fig. 12), with straight side teeth. Tarsal claws with 3–4 minute teeth. ♀-palp: claw with 2 tiny teeth.

♀ Epigyne/vulva: Figs 21, 22. Epigynal groove small, roughly triangular. Introductory ducts membranous with wide lumen. They run forwards, turn back and lead posteriorly into the receptacula. Dorsal recurrent part of introductory ducts extending beyond receptacula. Inner end of introductory duct more sclerotised, its lumen constricted. Receptacula seminis anterior to epigynal groove. Fertilization ducts long, connected by a sclerotised bridge.

Arguments for matching of sexes: *C. siam* ♂ occurred twice in the samples together with females. Unfortunately these females belong to different species! 2 ♂ 1 ♀ collected at Doi Angkhang 1500 m are thought to be conspecific, because of the altitude of this locality and restricted collecting at a small site only. Two other conspecific ♀ came from Doi Suthep 1150 m and Huay Nam Dang 1400 m, again at comparatively moderate altitude. 1 ♀ collected at Doi Inthanon 1780 m together with 1 ♂ of *C. siam* apparently belongs to another species, *C. orites* n. sp., which occurs at higher elevations. It was captured also at 2500 m! As collecting was done at Doi Inthanon by sieving over a large area, it is likely that the ♂ ♀ were not taken together.

E t y m o l o g y : noun in apposition, which refers to the former name of Thailand.



FIGS 6-12

Carniella siam n. sp., male (6, 11, Doi Inthanon), female (9, 10, 12, Doi Suthep). *C. schwendingeri* n. sp., male (7). *C. orites* n. sp., female (8). Carapace, lateral (6, 7) and dorsal view (8). ♀ Spinnerets (9). ♀ Chelicera, frontal view (10). ♂-palp, dorsal view (11). ♀ Tarsus IV (12). Scale lines 0.2 mm (6-8), 0.05 mm (9), 0.1 mm (10-12).

Distribution, habitat: *C. siam* is known from 4 localities in NW-Thailand, Chiang Mai Province. Most specimens were sieved from litter of evergreen lower montane forests at Doi Inthanon and at Doi Suthep, with Dipterocarpaceae and oaks predominant, from about 1000 m up to 1780 m. The species is not restricted to dense woodland. 2 ♂ 1 ♀ came from sieving herb litter in a deforested small valley with a stream at Doi Angkhang, 1 ♂ was taken in a pine forest (*Pinus merkusii*, *P. keysia*) with needle litter and little undergrowth at Doi Inthanon 1020 m. The habitat at Huay Nam Dang was a fragmented evergreen montane forest at 1400 m.

***Carniella schwendingeri* n. sp.**

(Figs 2, 3, 7, 16–18)

Material examined: Holotype: ♂ (MHNG), Khao Khieo 1020 m, Khao Yai National Park, Nakhon Ratchasima Province, NE-Thailand, 24.12.1992, P. Schwendinger leg.

D i a g n o s i s: ♂ clypeal knob low (Fig. 3), ♂ palp with distinctive embolus (Figs 16–18). ♀ unknown.

D e s c r i p t i o n: ♂ Measurements (mm): carapace 0.48 long, 0.40 wide. Length of abdomen 0.60. Sternum 0.28 long.

Colour: Carapace brown, with dark seam at its margins. Sternum and legs of same colour, patellae, trochanters and distal part of femora light brown. Abdomen grey, epigaster grey-brown.

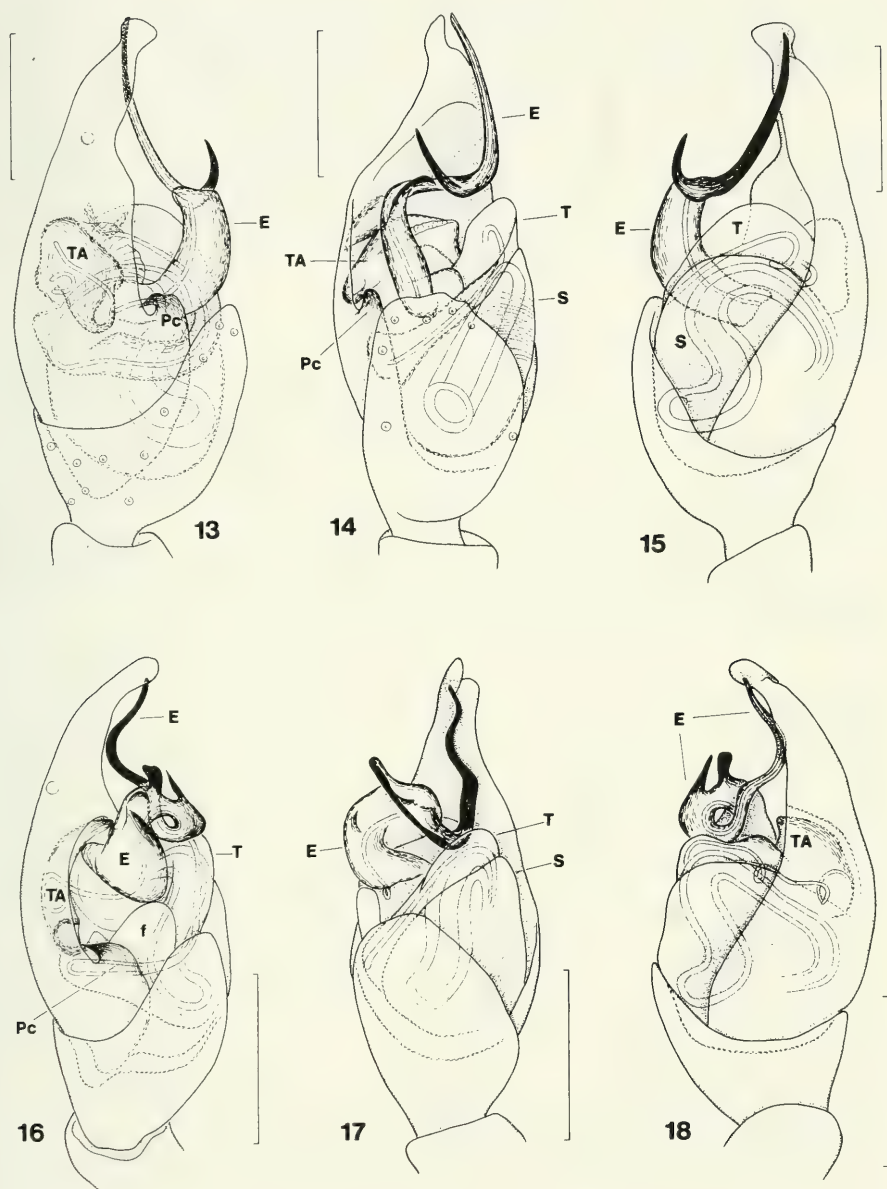
Clypeal projection less protuberant than in *C. siam* (Figs 2 vs. 1, 3 vs. 5, 7 vs. 6), covered with few short hairs. Sternum, labium, chelicerae and stridulatory organ as in *C. siam*. Sides of carapace also with membrane. Colulus large, with 2 setae.

Leg measurements (mm):

	Fe	Pa	Ti	Mt	Ta	Total
Palp	0.19	0.10	0.04	—	0.20	0.54
I	0.33	0.13	0.25	0.17	0.22	1.10
II	0.28	0.12	0.20	0.14	0.21	0.96
III	0.23	0.10	0.18	0.12	0.20	0.82
IV	0.32	0.13	0.26	0.16	0.22	1.10

Legs: 1 = 423. Numbers of prodorsal/retrodorsal trichobothria of tibiae I–II 1/2, III–IV 2/2, their position on I 0.14/0.08;0.30, on IV 0.11;0.28/0.30;0.60. Metatarsi I–II with 1 trichobothrium (0.35; 0.41). Tarsal organ I–IV (0.21–0.26). Tarsi I–IV 1.3–1.7 times longer than metatarsi. Tarsal claws with 3–4 minute teeth. Serrate bristles of legs I–IV as in *C. siam*.

♂ Palp: Figs 16–18. Tibia cone-shaped, without trichobothrium. Cymbium not twisted, slender, distally indented (Fig. 17), with basal hook-like paracymbium (Fig. 16). Subtegulum and course of sperm duct as in *C. siam*. Tegulum with transparent retrolateral fold (f, Fig. 16). Conductor absent. Tegular apophysis elongate, containing a loop of the sperm duct, in retrolateral-dorsal position, its retrolateral end presumably



FIGS 13-18

Carniella siam n. sp. (13-15, Doi Inthanon). *C. schwendingeri* n. sp. (16-18). Male palp, retrolateral (13, 16), ventral (14, 17) and prolateral view (15, 18). Scale lines 0.1 mm.

locking with paracymbium. Embolus a complex heavily sclerotised structure, its base broad, median part with 2 small side projections, one of which pointed, the other truncate, distal part slightly twisted.

E t y m o l o g y : The species is named after its collector.

D i s t r i b u t i o n , h a b i t a t : Known only from the type locality at Khao Khieo in the Khao Yai National Park. The specimen was collected by sieving moist leaf litter in semi-evergreen rain forest, with Dipterocarpaceae predominant, at 1020 m. Khao Yai belongs to an isolated mountain range in Central Thailand, distance from the localities of *C. siam* and *C. orites* ca. 500 km.

Carniella orites n. sp.

(Figs 8, 19, 20)

M a t e r i a l e x a m i n e d : Holotype: 1 ♀ (MHNG), 2400 m, 9.2.1986. Paratypes: 1 ♀ (MHNG), 1780 m, 3.3.1987. 1 ♀ (CTh), 2500 m, 14.7.–20.8.1987, pitfall trap. All specimens leg. P. Schwendinger at Doi Inthanon, Chiang Mai Province, N-Thailand.

D i a g n o s i s : ♀ epigyne/vulva (Figs 19, 20). ♂ unknown.

D e s c r i p t i o n : ♀: Measurements (mm): carapace 0.45 long, 0.40 wide. Length of abdomen 0.66. Sternum 0.30 long.

Colour: Carapace and legs brown, patellae light. Abdomen greyish.

Clypeus not modified (Fig. 8), stridulatory organ absent. Sternum, labium, chelicerae and spinnerets as in *C. siam*. Colulus with 2 setae.

Leg measurements (mm):

	Fe	Pa	Ti	Mt	Ta	Total
Palp	0.15	0.08	0.08	—	0.14	0.44
I	0.30	0.13	0.21	0.15	0.21	1.00
II	0.28	0.13	0.19	0.14	0.20	0.94
III	0.22	0.10	0.16	0.12	0.19	0.78
IV	0.31	0.14	0.26	0.15	0.22	1.07

Legs: 4123. Numbers of prodorsal/retrodorsal trichobothria of tibiae I–III 1/2, IV 2/2 ($n = 3$), their position on I 0.17/0.11;0.30, on IV 0.12;0.32/0.39;0.63. Metatarsi I–II with 1 trichobothrium (0.43; 0.46). Tarsal organ I–IV (0.26–0.31). Tarsi I–IV 1.4–1.6 times longer than metatarsi. ♀-palp: claw with one tiny tooth. Tarsal claws with 3–4 minute teeth. Serrate bristles on legs I–IV as in *C. siam*.

Epigyne/vulva: Figs 19, 20. Epigynal groove larger than in *C. siam*, oval, anterior border semi-circular, median sclerotised structure present. Ventral part of introductory duct pear-shaped, widened posteriorly, dorsal recurrent part not extending laterally beyond receptaculum. Receptacula seminis at anterior border of epigynal groove. Glandular pores at inner end of introductory ducts and on receptacula. Fertilization ducts similar to *C. siam*.

E t y m o l o g y : The specific name refers to the high montane habitat.

Distribution, habitat: Known only from Doi Inthanon, Chiang Mai Province, in montane forest from 1780 m up to the summit 2500 m. Lowest occurrence at 1780 m together with *C. siam*. The summit forest is heavily covered with moss, owing to prevalent cloud cover.

Carniella weyersi (Brignoli, 1979) nov. comb.

(Figs 23, 24)

Theonoe weyersi Brignoli, 1979

Material examined: 2 ♀ (holotype and paratype), Sumatra, Weyers leg., Coll. Simon, AR 1020 MHNP (see BRIGNOLI, 1979).

Description: Measurements (mm): Holotype: carapace 0.44 long, 0.31 wide. Length of abdomen 0.50. Paratype: carapace 0.44 long, 0.33 wide.

Sides of carapace with membrane. Spinnerets as in *C. siam*.

Legs: Numbers of prodorsal/retrodorsal trichobothria of tibiae I–II 1/2, III–IV 2/2 (n = 2). Metatarsi I–II with 1 trichobothrium.

Epigyne/vulva: Figs 23, 24. Epigynal groove large, oval, with median triangular cavity, where the introductory ducts apparently begin. Ventral part of introductory duct as a short membranous atrium, dorsal part membranous, with wide lumen, forming a loop, sclerotised part with constricted lumen, leading directly backwards into the receptaculum. Receptacula seminis at posterior border of the epigynal groove. Glandular pores near the entrance of the introductory ducts. Fertilization ducts similar to *C. siam*.

New combination, synonymy: “*T.*” *weyersi* does not belong to *Theonoe* according to its epigyne/vulva, but is clearly allied to *Carniella*: epigynal groove, course and form of introductory ducts correspond basically to the Thai species, though these differ specifically. Vulval structures resemble those of *C. detriticola*. *C. weyersi* and *C. detriticola* probably belong to another species group.

The possibility cannot be excluded that “*Theonoe weyersi*” in SIMON (1926) is merely an error and not a nomen nudum as thought by BRIGNOLI (1979). The species was formally described by Brignoli from 2 ♀ found in the Simon collection, named “*T. weyersi*”. SIMON (1899) described only 1 *Theonoe* species from Sumatra, *T. globifera* (♂ ♀), which was followed by the description of *Iardinis weyersi*. Possibly therefore the ‘nomen nudum’ *T. weyersi* in SIMON (1926) and in his collection might be only a slip of the pen.

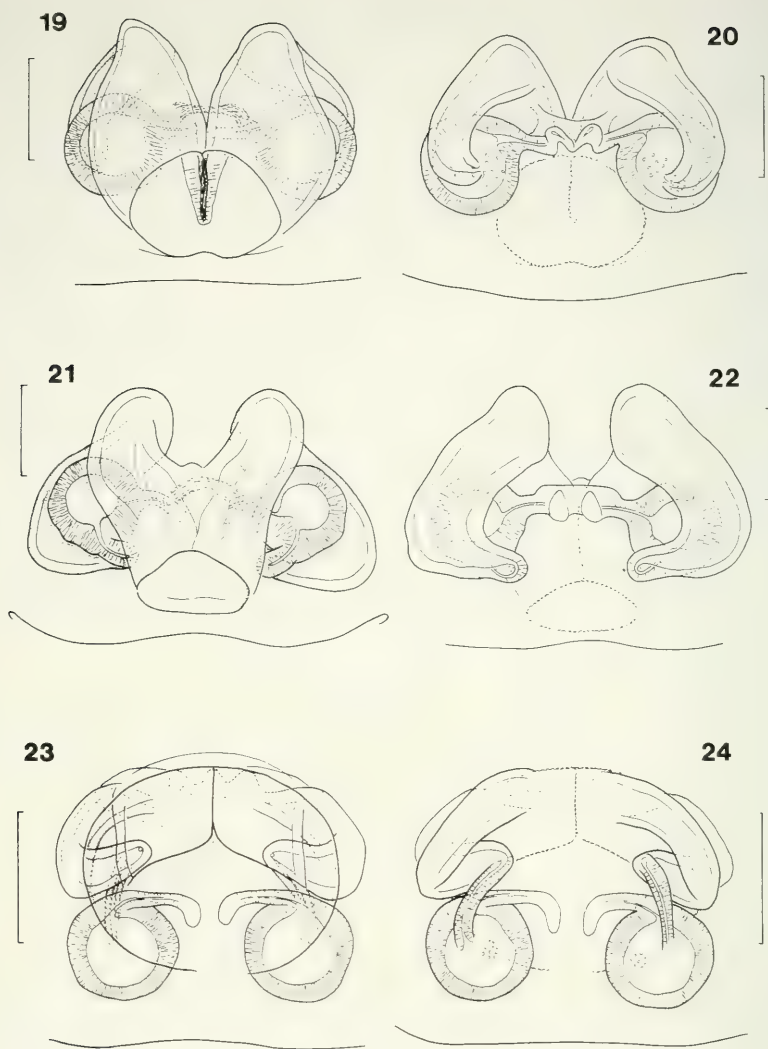
Theonoe weyersi has also been recorded from China, Mount West Tianmu. The figures of epigyne/vulva in SONG & KIM (1991, fig. 8, 9) do not correspond clearly to the females from Sumatra, as the receptacula are shown antero-laterally to the epigynal groove. The identity of this specimen should be reinvestigated.

Carniella globifera (Simon, 1899) nov. comb.

Theonoe globifera Simon, 1899

C. weyersi (Brignoli, 1979) ?

According to the description of SIMON (1899), *Theonoe globifera* from Sumatra belongs to *Carniella*: male as in *C. brignolii* with characteristic globular



FIGS 19–24

Carniella orites n. sp. (19, 20). *C. siam* n. sp. (21, 22, Doi Suthep). *C. weyersi* (Brignoli) (23, 24). Epigyne/vulva, ventral (19, 21, 23) and dorsal view (20, 22, 24). Scale lines 0.05 mm.

clypeal protuberance (SIMON 1899: 86). ♂ palp with long slender cymbium (“*tarso magno, ovato, longe acuminato*”) and with complicated, heavily sclerotised embolus (“*loboque apicali nigro subtriquetro, stylo gracili apicali instructo, minuto*”). The species was taken around Indrapoera, ca. 150 km south of Padang on the mountainous W-coast of Sumatra.

Specimens labelled as *T. globifera* cannot now be traced in the Paris collection. Concerning *C. weyersi* see above.

***Carniella detriticola* (Miller, 1970) nov. comb.**

Theonoe detriticola Miller, 1970

This African species must also be transferred to *Carniella*. The following characters support this new combination: shape of sternum, tarsi longer than metatarsi, tarsi I–IV with serrate bristles, vulva of similar structure, membranous ventral part of introductory ducts wide, sclerotised part constricted, receptacula close to the epigastric furrow (fig. 5, p. 158, MILLER 1970). *C. detriticola* stands close to *C. weyersi*, their vulval structures being quite similar. *C. detriticola* was found in ground litter of a gallery forest at Luisavo waterfall (Angola) at 1300 m (18.2.1955). ♂ unknown.

DISCUSSION

AFFINITIES

The new species described from Thailand are clearly related to *Carniella brignolii* THALER & STEINBERGER (1988), recently described from Europe. Important common characters are: ♂ clypeal modification present, cymbium distally modified, paracymbium proximal, conductor absent, embolus complicated. Apparently the “terminal apophysis” of THALER & STEINBERGER (TA figs 11, 14) is the embolar base. In the Asian species there is no prominent basal hematodocha and the tarsus of the male palp is not twisted, so probably these belong to another species group. WUNDERLICH (1994) has reported on further relatives in SE-Asia.

The species described by SIMON, BRIGNOLI & MILLER were placed hitherto in *Theonoe*. Therefore it might be useful to indicate diagnostic differences:

		<i>Carniella</i>	<i>Theonoe</i>
♂	– clypeus	modified	not modified
	– paracymbium	proximal	distal
	– conductor	absent	present
	– embolus	complicated	short
♀	– introductory ducts	long, widened	short, narrow

Characters common with *Theonoe* are: ♂ stridulatory organ present; colulus relatively large, with 2 setae; tarsi I–IV with serrate bristles; tarsi longer than metatarsi; ♂-palpal tibia cone-shaped, without trichobothrium; cymbium distally modified; tegular apophysis anchored to paracymbium (HEIMER 1982), with loop of sperm duct. Most of these characters apparently qualify as plesiomorphic. For details on *Theonoe* see WIEHLE (1937) and LEVI & LEVI (1962).

Owing to the exceptional proximal position of the paracymbium FORSTER *et al.* (1990) suggested a separation of *Carniella* from Theridiidae. However, the male palp

of *Carniella* shows locking system A of this family (SAARISTO, 1978): paracymbium hook-like, presumably anchoring the tegular apophysis in the expanded palp. Also, this apophysis contains a loop of the sperm duct. As in Theridiidae, in *Carniella* the tibia is cone-shaped, without apophyses; labium not rebordered, chelicerae with basal extension. Also the stridulatory organ is typically theridiid.

Nevertheless, *Carniella* lacks the typically widened spigots on the posterior lateral spinnerets as well as the theridiid tarsal comb on leg IV. Instead, 2 rows of serrate bristles are present on tarsi I–IV, as in *Theonoe*. In another small soil-dwelling spider, *Comaroma simoni* Bertkau (Anapidae), similar serrate bristles on legs I–IV are used for cleaning, not for manipulating viscid silk during prey capture (KROPF 1989). So a cleaning function of tarsi I–IV in *Carniella* and *Theonoe* is likely.

DISTRIBUTION

Several species of *Carniella* are now known from montane forests in SE-Asia: *C. globifera* and *C. weyersi* from Sumatra (SIMON 1899; BRIGNOLI 1979), "*C. weyersi*" from China (SONG & KIM 1991), and 3 species described herein from Thailand (*C. siam*, *C. schwendingeri*, *C. orites*). Another species, *C. detriticola*, was recorded from montane forest in Angola (MILLER 1970). The type species *C. brignolii* occurs in mid-Europe: Austria, Bavaria and Belgium. It was found on a southerly exposed slope with stones and sparse vegetation (HALER & STEINBERGER 1988), on a gravel bank of a river (DRÖSCHMEISTER 1994) and in an abandoned quarry with sparse vegetation (BAERT & VAN KEER 1991). In the tropics *Carniella* apparently is confined to montane regions. The reasons for the disjunct distribution of the genus *Carniella* in SE-Asia, Africa and Europe are not yet understood.

ACKNOWLEDGEMENTS

Many thanks are due to Dr P. Schwendinger for providing material and information. I am grateful to Dr K. Thaler for discussion and literature, to Dr J. Heurtault for loan of material and to Dr P. Merrett for linguistic revision.

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ADDENDUM

When this paper was in press, two further *Carniella*-species were described from Indonesia (WUNDERLICH 1995): *C. krakatauensis* (♂) from Anak Krakatau, *C. sumatraensis* (♂ ♀) from N-Sumatra. *C. schwendingeri* is similar to *C. krakatauensis*.

WUNDERLICH, J. 1995. Südostasiatische Arten der Gattung *Carniella* THALER & STEINBERGER 1988, mit zwei Neubeschreibungen (Arachnida: Araneae: Theridiidae). *Beiträge zur Araneologie*, 4 (1994): 553–558.

***Spalacosostea*, an anomalous new terrestrial dryopid from South East Asia (Coleoptera: Dryopidae)**

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***Spalacosostea*, an anomalous new terrestrial dryopid from South East Asia (Coleoptera: Dryopidae).** - A new genus, *Spalacosostea* with two new species, *S. loebli* from Borneo and *S. pselaphoides* from Sumatra, is described. Both species were sifted from vegetation debris in rain forest. They are unusual for their small size and notable for sexual dimorphism, affecting the metathoracic wings and sensory organs. Females are wingless, with membranous metanotum, suboval elytra, vestigial eyes and short maxillary palps. Males have metathoracic wings well developed, metanotum well sclerotized and composed from several parts, large eyes, and their maxillary palps are very long and bear conspicuous peg-like sensilla. Taxonomically significant structures and morphological features unique to the *Spalacosostea* are discussed and illustrated. Diagnostic key to the species is given.

Key-words: Coleoptera - Dryopidae - *Spalacosostea* - Oriental region - Taxonomy - Morphology - Antennal sensilla.

INTRODUCTION

The family Dryopidae, of almost world-wide distribution (BROWN 1981), presently consists of 240 species in 24 genera. They live in a variety of freshwater and terrestrial habitats. Many adults inhabit running waters and exhibit respiratory adaptive features, such as microplastron structures in *Pomatinus* Sturm, 1853 and *Elmomorphus* Sharp, 1888. In the contrary, the riparian dryopids (BARR & SPANGLER, 1992), e.g. *Dryops* Olivier, 1791, *Pelonomus* Erichson, 1847 and *Onopelmus* Spangler, 1980, evolved macroplastron structures (HINTON 1969). Some of these species undertake dispersal flights and are often taken in great numbers in light traps. The few known larvae, are terrestrial or semiaquatic (BROWN 1987).

The entirely terrestrial groups, e.g. *Geoparnus* Besuchet, 1978, *Sosteamorphus* Hinton, 1936 and *Oreoparnus* Deleve, 1965, have been found in forest leaf litter and

flood debris. They are generally characterized by a very compact, heavily sclerotized, more or less ovoid body without plastron structures. Most of them lack metathoracic wings, have relatively small eyes, and their elytral striae are often strongly developed. Members of the Neotropical *Quadryops* Perkins & Spangler, 1985 were found in arboreal habitats, and those of the Indo-Malaysian *Sostea* Pascoe, 1860 were beaten from the foliage of different plants in rain forests (Kodada, unpublished). The arboreal dryopids may be roughly distinguished from the epigeal ones by the more elongate body, the presence of large eyes, the well-developed metathoracic wings and the elytra which often have a metallic shine.

To date, nine dryopid genera have been recorded from the Oriental Realm, two of which (*Geoparnus* and *Sostea*) are terrestrial.

Two species of an additional terrestrial dryopid genus have been found by I. Löbl, D. H. Burckhardt, D. Agosti and A. Smetana in northern Borneo and Sumatra. These unusually small epigeal dryopids exhibit remarkable sexual dimorphism affecting particularly the metathoracic wings and the sensory organs.

MATERIAL AND METHODS

Members of following genera of terrestrial dryopids were studied: *Geoparnus setifer* Besuchet, 1978 - holotype: ♂, paratypes: 1 ♂, 1 ♀ (MHNG); *Geoparnus* sp. - five undescribed species of both sexes (MHNG, CKB); *Guaranius carlosi* Spangler, 1991 - 2 ♂♂ (NMW); *Sostea tuberculata* (Bollow, 1940) - holotype: ♀ (RMS); *Oreoparnus microps* Deleve, 1965 - paratype: 1 ♂ (MHNG); *Protoparnus* sp. - 1 ♂ (CKB); *Sostea crassa* Hinton, 1936 - holotype: ♀ (BMNH); 2 ♂♂, 2 ♀♀ (CKB); *Sostea elmoides* Pascoe, 1860 - syntypes: 2 ♂♂, 2 ex. sex not examined (BMNH), 2 ♀♀ (CKB); *Sostea hirtifera* Waterhouse, 1876 - holotype ♂, (BMNH), M, F (CKB); *Sostea pilula* Grouvelle, 1898 - syntypes: 1 ♂, 2 ♀♀ (MNHP); *Sostea westwoodii* Pascoe, 1860 - syntypes: 2 ♂♂, (BMNH), 1 ♀ (BMNH); *Sosteamorphus verrucatus* Hinton, 1936 - 4 ♂♂, 4 ♀♀ (TMP); undescribed genus A from South Africa (Natal Middld., Doreen Clark Nat. R.) - 2 ♂♂, 2 ♀♀ (TMP); undescribed genus B from Venezuela (Sierre Nevada) - 1 ♂ (NMW).

Specimens used for morphological studies were relaxed in water, cleaned and treated with lactic acid. Metathoracic wings were removed, spread and observed on unmounted slides. For scanning electron microscopy specimens were dehydrated in graded ethanol series and air-dried from absolute ethanol, mounted on stubs with Tempfix and sputter coated with gold. Illustrations were prepared with aid of a drawing tube, using temporary transparency mounts. The differentiation of the sensilla is based only on the form and size of their cuticular parts. The terminology of the metathoracic wing structures follows KUKALOVÁ-PECK & LAWRENCE (1993).

ABBREVIATIONS

BMNH	Natural History Museum, London
CKB	Kodada collection, Bratislava
MHNG	Muséum d'histoire naturelle, Genève

MNHP	Museum National d' Histoire Naturelle, Paris
NMW	Naturhistorisches Museum, Wien
RMS	Naturhistoriska Riksmuseet, Stockholm
TMP	Transvaal Museum, Pretoria
D	Dendritic sensilla
DF	Digitiform sensilla
P1, P2, P3, P4, P5	Peg-like sensilla
S1, S2	Styloconic sensilla
TL, TM, TS, T1, T2	Hair-like sensilla
EL	Elytral length
EI	Elytral index, ratio of elytral ML to combined MW of elytra
HW	Width of head with eyes
LPE	Medial length of pronotum and elytra
ML	Medial length
MW	Maximum width
OI	Ocular index, ratio of HW to minimum distance between eyes
Ø	Mean value ± standard deviation
n	Number of measured specimens

SYSTEMATIC SECTION

Spalacosostea gen.n.

(Figs 1-65)

Type species: *Spalacosostea loebli* sp.n.

Gender: feminine.

Etymology: The generic name is a combination of names *Spalax* (Spalacidae: Rodentia) and *Sostea*. *Spalax* are short-legged mammals that are extensive burrowers, characterized by the absence of external openings for eyes, although small eyes are present beneath the skin (referring to the vestigial eyes of females from the genus described below). *Sostea* is a dryopid similar to the new genus.

Diagnosis: *Spalacosostea* may be distinguished from all other described dryopids by following features in combination: (1) antennae six-segmented, pectinate with enlarged antennomere 1; (2) eyes in female vestigial; (3) male maxillary palpus with terminal segment unusually large, bearing conspicuous peg-like sensilla with an enlarged, sharply tipped apex on almost entire surface; (4) metathoracic wing with highly reduced anal veins; (5) tarsi four segmented.

The wingless female with membranous metanotum, suboval elytra, short maxillary palps and vestigial eyes, differ conspicuously from male. The male is characterized by the well sclerotized metanotum composed from several parts and developed metathoracic wings, elongate elytra, large eyes and very long maxillary palps with conspicuous sensilla. The association of both sexes is based also on similar: (1) types and distribution of the sensilla on the antennae, labium, labrum and legs; (2) shape of the labrum, labium and maxillae (maxillary palps excepted); (3) type of the macro- and micropunctuation; (4) vestiture; and (5) both sexes of each species were found in the same samples.

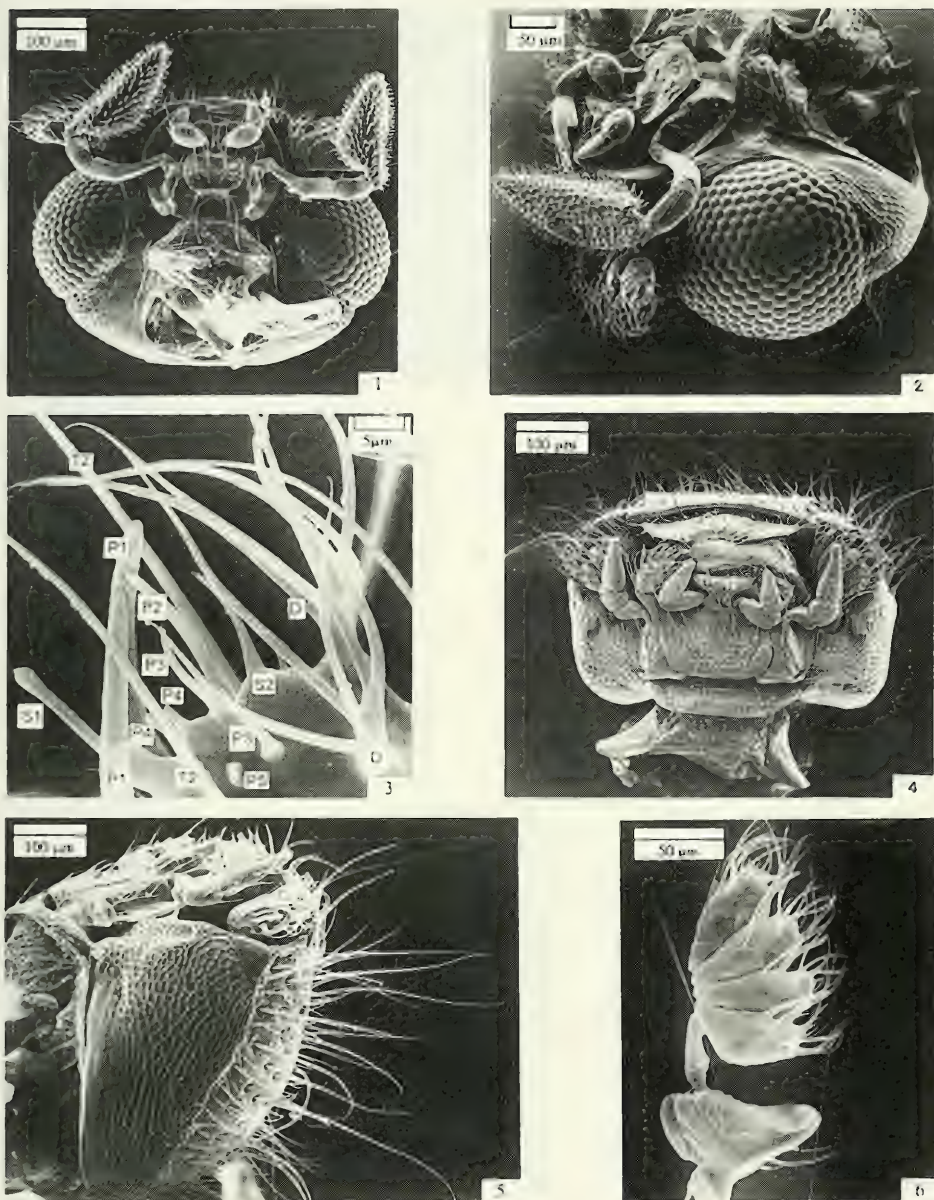
Description ♂: Body form elongate (Fig. 49), slender, moderately convex dorsally; about 2.4 times as long as wide (LPE/MW); length 1.20 - 1.60 mm (LPE). Colour in both sexes varies from yellowish-brown to brown with yellowish antennae and legs (obviously depending on maturity).

Vestiture of dorsal surface (Figs 19, 26, 35) consisting of three types of yellowish hair-like sensilla. Type TL = very conspicuous, erect, about 200 - 300 μm long, arising from more or less deep, indistinctly bordered sockets; longest sensilla (TL) inserted on lateral elytral and pronotal margins. Type TM = intermediate, about 100 - 170 μm long, erect, arising from shallow socket; longest sensilla (TM) situated on pronotum and elytra. Type TS = short, thin, about 40 - 70 μm long, recumbent and arising from shallow inconspicuous socket. Ventral surface with similar hair-like sensilla as dorsal surface, but sensilla (TL, TM) arise mostly from large, shallow and very distinctly bordered sockets (Figs 20, 23, 32). Some specimens covered with encrusted material on cuticle of vertex and pronotum.

Head (Figs 1, 2, 26, 27) hypognathous, flat ventrally, arched dorsally and laterally; occipital area distinctly shorter than longest eye diameter; moderately retracted into prothorax. Punctuation consisting of setigerous micro- and macropunctures. Micropunctures (sockets of sensilla TS) mainly on vertex and near occipital ridge; distance between micropunctures about 0.5 times length of sensilla (TS). Macropunctures represent sockets of sensilla (TL, TM), deeper and broader near eyes than on frontoclypeus and separated by a distance of about 1 - 3 facet diameters. Eyes (Figs 1, 2, 26) large, more or less protuberant, circular, coarsely faceted and only with a few interfacetal sensilla (cf. type TM) on their dorsal half.

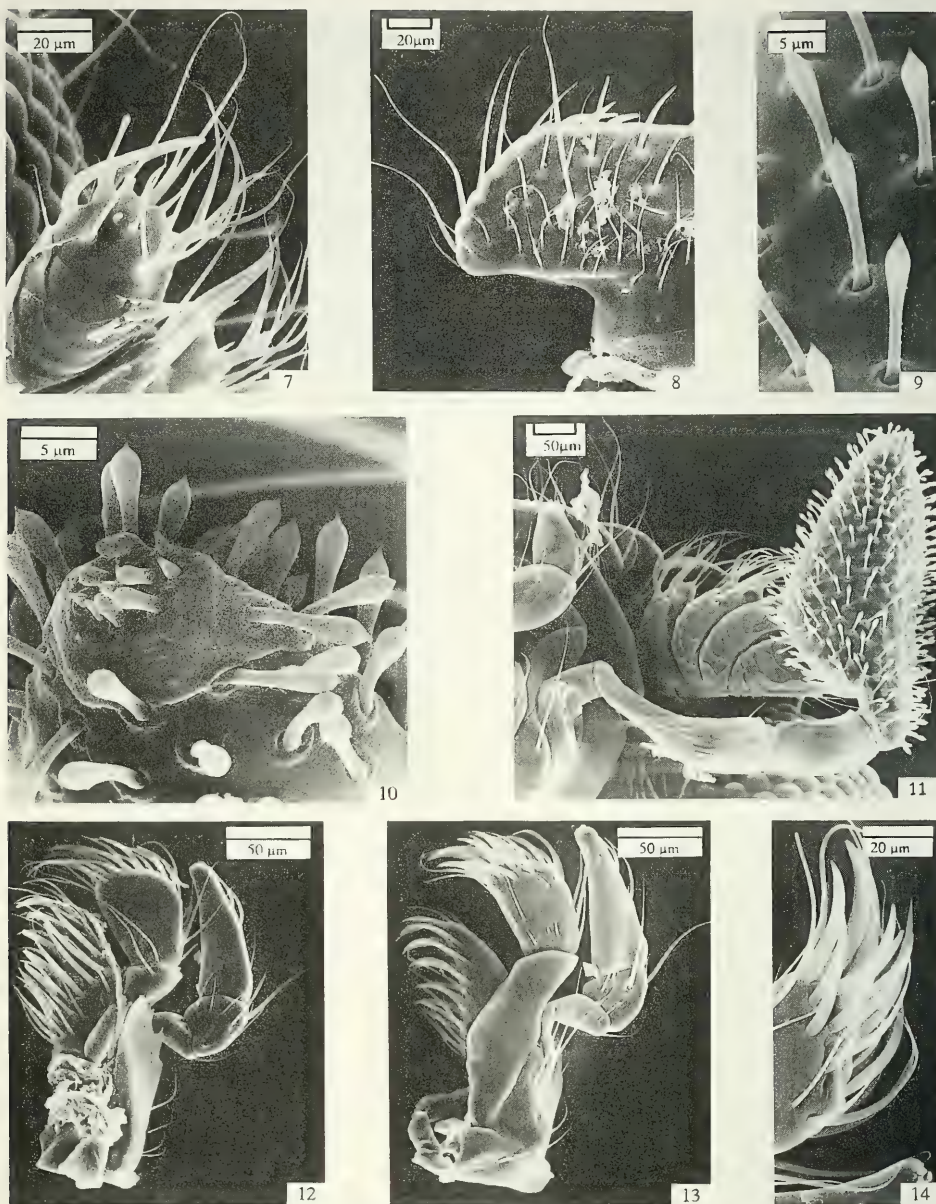
Labrum (Fig. 8) short (MW/ML = about 1.6), in posterior half strongly and abruptly constricted to third of MW and concealed by clypeus. Lateral tormal processes very short, bent ventro-mesally; postero-median process absent. Anterior margin more or less emarginate, with a few closely arranged, bluntly tipped, peg-like sensilla; lateral margin arcuate, with few hair-like sensilla. Epipharynx with two lateral fields of moderately long, mesally directed, recumbent hair-like sensilla (about as type TS), and postero-mesal rows of short and very closely set setae bordered laterally by flat, broad setae. Anterior margin of clypeus arched, with a flat ridge; frontoclypeal suture absent.

Antennae (Figs 3, 6, 7, 51) inserted into deep antennal sockets, six-segmented, microreticulated. Antennomere 1 robust, dilated distally, dorsally with sensilla TM and one sensillum TL; latero-dorsal margin with flat ridge adjacent to clypeal ridge in repose. Antennomere 2 as long as previous one, cylindrical and constricted in basal third; antennomeres 3 - 6 dilated anteriorly, approximately of same length. Sensory fields located on antero-median extension of each flagellar antennomere. Terminal antennomere (Fig. 3) contains greatest number of different types of sensilla: (1) hair-like sensilla type T1 = about 20 - 35 μm long and 1 μm wide at base; lateral and dorsal face with 6 - 8 sensilla T1; (2) type T2 = about 60 - 100 μm long and about 2 - 3 μm wide, finely longitudinally grooved, one subapical sensillum T2, bilaterally symmetrical on each side of the midline; (3) styloconic sensilla type S1 = approximately 30 μm long and 4 - 5 μm wide (MW), bluntly tipped peg inserted at tip of cylindrical projection, medio-dorsal face bears one subterminal sensillum S1; (4) type S2 = about 10 μm long and 1 μm wide, slightly bent, sharp tipped conical peg inserted on broad, short, basal projection, each antennomere bears only one median sensillum S2; (5) peg-like sensilla type P1 = approximately 35 - 40 μm long, 4 - 5 μm



FIGS 1-6

Spalacosostea loebli sp.n.: 1, head of male, ventral view; 2, lateral view; 3, sensilla of the terminal antennomere; 4, head of female, ventral view; 5, lateral view; 6, antenna of male.



FIGS 7-14

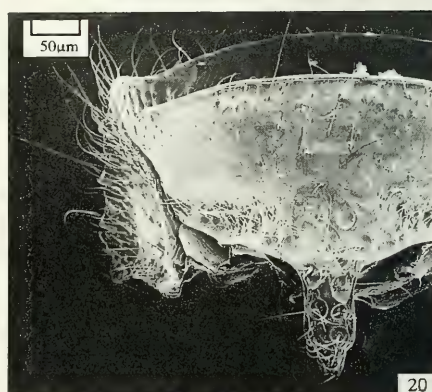
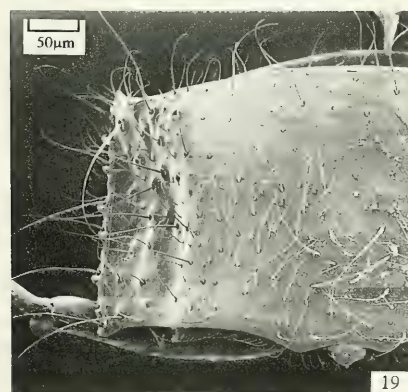
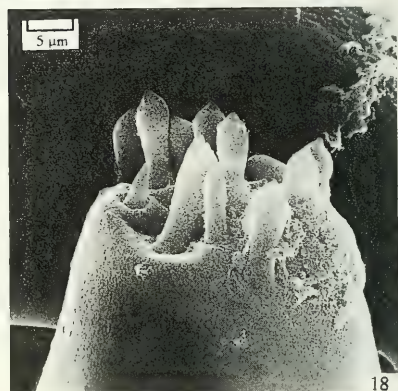
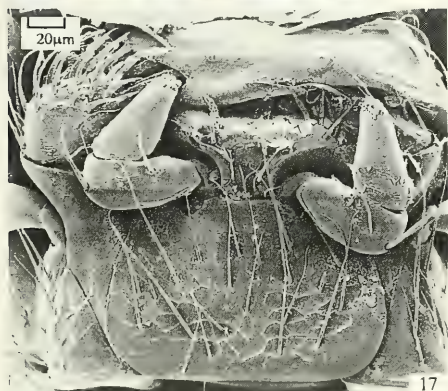
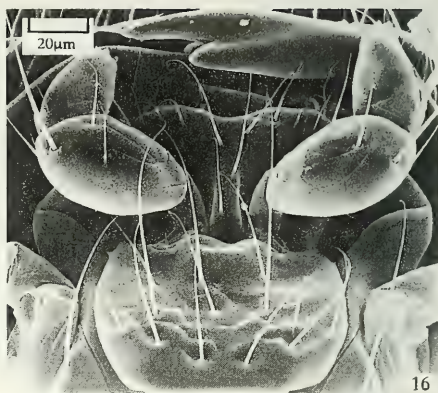
Spalacosostea loebli sp.n.: 7, terminal antennomere, male; 8, labrum, dorsal view; 9, sensilla of the maxillary palpus, male; 10, apex of maxillary palpus, male; 11, maxillary palpus, male; 12, maxilla of female, ventral view; 13, dorsal view; 14, apex of galea.

wide, slightly bent, bluntly tipped, two sensilla P1 inserted without a socket posteriorly to sensilla T2; (6) type P2 = one 25 - 30 μm long, about 3 μm wide, bluntly tipped peg without socket inserted sublaterally on dorsal face anteriorly to sensillum P1; (7) type P3 = about 10 μm long, 1 μm wide, thin, bluntly tipped pegs, without socket, one median sensillum P3 before sensillum S2 and two P3 laterally to S2; (8) type P4 = about 5 μm long, 1 μm wide, 0 or 2 sensilla P4 present on medio-distal area before sensillum S2; (9) type P5 = only one, very short conical peg about 2 μm long and 1 μm wide, inserted on dorsal face near lateral sensillum P3; (10) dendritic sensilla (Perkins & Spangler, 1985), type D = conspicuous branched sensilla without socket, about 45 μm long and 6 μm wide at base, antennomeres 3 to 6 bear 1 or 2 sublateral sensilla D. Antennomeres 3 to 5 similar to each other in sensillar distribution, but lacking sensilla S1, P2, P3, P4, and number of sensilla T1 reduced compared to antennomere 6.

Mandibles (Fig. 15) asymmetrical, short and broad, flattened dorso-ventrally, heavily sclerotized, with convex external margin. Ventral and dorsal surface glabrous; outer surface bordered dorsally by a distinct edge, moderately concave in proximal 0.66, microsculptured and with short hair-like sensilla. Right mandible with 4 teeth, dorso-proximal tooth very small; molar lobe strongly convex. Left mandible with three teeth and concave molar lobe. Prostheca (lacinia mobilis) hyaline, short, with closely inserted short spines. Each mandible bears many campaniform sensilla (PETRYSZAK 1977) and pore canal organs (ZACHARUK 1985) on teeth and in mola.

Maxilla with small cardo; stipes divided into small triangular basistipes and large elongated mediostipes; palpifer large, externally dilated into more or less broad lamina; both basistipes and palpifer with hair-like sensillum; mediostipes with several dorso-distal hair-like sensilla. Galea dorso-ventrally flattened, apically slightly dilated, about 0.5 times as long as mediostipes, with a few hair-like sensilla on ventral and dorsal side (mainly near base) and along external margin; distal region of galea bears a cluster of closely arranged, moderately bent stout setae. Lacinia triangular, flat, slightly shorter than mediostipes; dorsally and along internal margin with rows of strong bent setae; subapical external, dorsal and ventral submedian area of lacinia with several hair-like sensilla. Maxillary palps (Figs 11, 30) four-segmented, about as long as MW of head; segment 1 tiny; segment 2 more or less curved, distally dilated, about 4 times as long as segment 1 and about 1.6 - 1.9 times as long as segment 3; segments 2 and 3 microreticulated and with few short hair-like distal sensilla. Terminal segment expanded, robust, slightly shorter than length of two preceding ones combined, covered almost entirely with conspicuous peg-like sensilla with an enlarged, sharply tipped apex (Fig. 9). Terminal cluster of sensilla (Fig. 10) with bluntly tipped and distally enlarged pegs; conical, short, bluntly tipped pegs; and subterminal flattened, peg-like, partly sunken sensillum. Basal sensillar cluster (if present) consists of 4 peg-like, bluntly tipped sensilla.

Submentum short; mentum flat, with several hair-like sensilla (Fig. 16), lateral sides variably arcuate, lateral portion of anterior margin emarginate (Fig. 31), medial portion protruding; mental apodemes about as long as ML of mentum, narrow and bent distally. Prementum short and concealed by mentum, represented by a pair of



FIGS 15-20

Spalacosostea loebli sp.n.: 15, mandible, ventral view; 16, labium, male; 17 labium, female; 18, apex of labial palpus, male; 19, pronotum of male, dorsal view; 20, ventral view.

sclerites. Palpus labialis three-segmented; segment 1 short, inconspicuous, without hair-like sensilla; segment 2 robust, about 1.8 times as long as wide (ML/MW), with inner side almost straight, outer side strongly convex, distal half with several short hair-like sensilla and long subapical external hair-like sensillum; segment 3 about as long as preceding, nearly conical. Apical sensory field (Fig. 18) similar to those on maxillary palpus, basal sensory field with two hair-like sensilla and digitiform (DF) sensillum (HONOMICHL & GUSE 1981). Ligula basally constricted, as long as prementum; antero-lateral portion rounded and laterally only weakly sclerotized; anterior margin medially more or less deeply emarginated; proximal half ventrally with two broad deep depressions on almost 0.8 of width of ligula; ventral surface bearing several hair-like sensilla and two bluntly tipped, bent, submedian peg-like sensilla near anterior margin; dorsal surface (hypopharynx) with short mesally directed hair-like sensilla in two pairs of sensory fields, each pair separated by a triangular area covered with longer, hair-like sensilla.

Dorsal tentorial arms long, thin and slightly surpassing middle of cranium; anterior tentorial pits not visible; posterior tentorial pits conspicuous; posterior tentorial arms joined by a transverse bridge, bearing two short bent and flattened processes. Gula short (MW/ML = about 4), trapezoidal, almost flat, finely micro-sculptured; gular sutures distinct. Occipital ridge (Fig. 26) fine, separating smooth dorsal surface from sculptured ventral parts. Occipital foramen large, in ventro-lateral angles articulating with apices of large cervical sclerites.

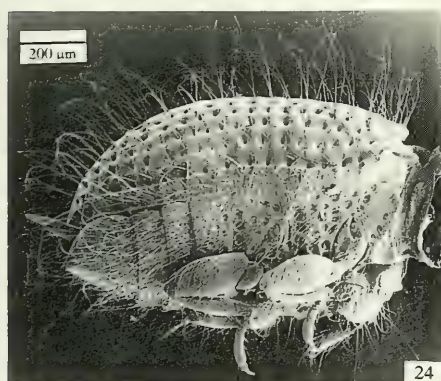
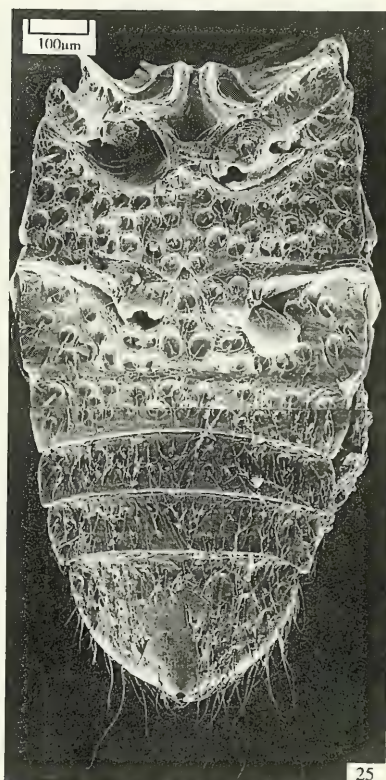
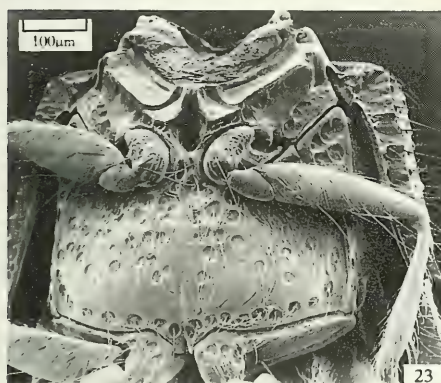
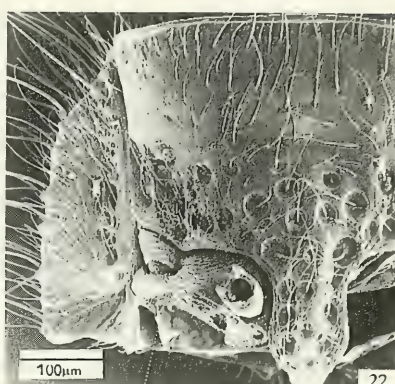
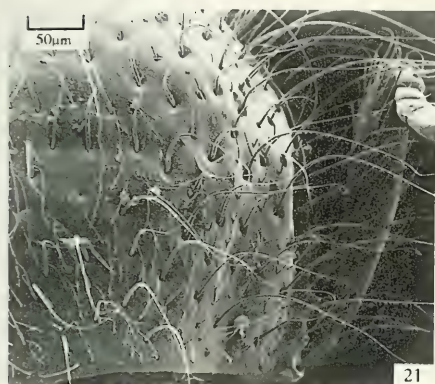
Pronotum moderately convex dorsally; with conspicuous longitudinal impression (Fig. 19) laterally; anterior margin arcuate, with a shallow emargination on lateral portions; lateral margin slightly arcuate or almost straight, finely crenulate and explanate; posterior angles almost rectangular; posterior margin trisinuate; central area usually with numerous sensilla (TS, TM), marginal areas mainly with sensilla TL. Internal posterior notal region bears two small condyles and a pair of ridges, latter fitting into cavities on anterior margin of elytra. Hypomerone (HINTON 1939) basally broadest, in apical third strongly narrowed (Fig. 20), with punctation variable. Prosternum bordered anteriorly by a flat ridge, rounded at antero-lateral angles and separated from hypomerone in distal fourth; about 0.5 times as long as wide in front of procoxae; strongly deflexed and finely, sparsely punctured in anterior third; remaining surface with large, flat bottomed punctures. Prosternal intercoxal process narrow (Fig. 20), about 2.4 times as long as wide, constricted and bluntly tipped in apical third; procoxal cavities open posteriorly; trochantin large. Mesosternum and mesepisternum concave anteriorly, glabrous; exposed part of mesepisternum with a transverse row of macropunctures anteriorly; mesepimeron with macropunctures; median mesosternal cavity deep, receives apex of prosternal process; mesocoxal cavities oval (dorsal view); mesosternal furca with slightly divergent arms. Scutellum small and subtriangular (MW/ML = 1), glabrous, with arcuate sides. Metasternum about 3 times as long as mesosternum (ML/ML), convex ventrally, without (Fig. 32) or with only very short, shallow longitudinal impression in posterior third (Fig. 23); median longitudinal endocarina present in posterior half; transversal suture (CROWSON 1967) absent, but its presumed position marked by a transverse row of macropunctures;

metasternal intercoxal process apically emarginate, as long as wide. Macropunctures on lateral areas of metasternum and on long, exposed triangular area of metepisternum, but almost absent medially and on most of submedial-proximal areas of metasternum. Metendosternite with a long, narrow stalk; lateral arms and anterior tendons slender and short. Metanotum about 3 times as long as mesonotum; both divided into prescutum, scutellum and lateral scuta (LAWRENCE & BRITTON 1991); postnotum strongly transverse and slightly shorter than mesonotum.

Elytra elongate and parallel-sided in anterior 0.66, evenly arched towards apex (Fig. 35); flat dorsally in cross section, deflexed laterally; apices more or less acute (Fig. 36); anterior margin slightly elevated and finely crenulate; humeri prominent; sutural margin slightly elevated. Each elytron with 9 more or less regular rows of deeply impressed and densely arranged punctures (striae) between explanate lateral and sutural margin; striae 2, 3, 7 and 8 ending on elytral declivity, striae 5 and 6 ending before, striae 1, 4, 9 reaching apex. Strial intervals slightly convex, narrow; unpaired intervals with rows of sensilla (TL, TM), paired intervals bearing a double row of sensilla TS. Epipleura reaching elytral apex, about as wide as apex of tibia basally, narrowed apically (Fig. 32), oblique ventrally, more or less coarsely punctate and set with sensilla (TL) along finely denticulate lateral margin. Ventral elytral flange short and placed laterally slightly anterior to middle (Figs 36, 37, 38) near a "rubbing patch" (CROWSON 1981).

Metathoracic wing (Fig. 56) about 2 times as long as elytron, slightly pigmented; apical field occupies almost 0.66 of wing; anterior margin composed of precosta (PC), costa (C) and subcosta anterior (ScA). Subcosta posterior (ScP) and darker pigmented radius anterior (RA) run parallel and close to anterior margin; both together form distally a radial bar ending abruptly, short before middle of wing; pigmented strips situated under radial bar. Radius posterior (RP) developed only in distal portion of wing being integrated into medial loop; radial cross-vein (r4) connecting presumed position of radial cell (incompletely bordered) with medial hook; posterior radial branches only slightly pigmented, broadened and flattened and not connected with RP. Media posterior (MP1+2) broad, dark pigmented and distally fused together with RP and cross-vein rp-mp2 to form medial hook; medial spur hardly distinguishable. All veins in medial field broadened, flattened, slightly pigmented and not reaching posterior wing margin; MP 3+4 short, forking into simple MP3 and MP4 fusing with CuA 1+2; cubitus anterior (CuA) forks into CuA1+2 and CuA 3+4; slightly pigmented spots remain from anal anterior and posterior sectors of anal veins.

Procoxae transverse, approximately cylindrical, about 3 times as wide as long; mesocoxae shorter, nearly conical; metacoxae transverse, with posterior excavation for reception of femora. Pro- and mesofemur about 1.5 times as long as procoxa; both broadest near middle; metafemur slightly longer than mesofemur, broadest basally, with straight dorsal and ventral outlines; all femora with short and long hair-like sensilla, longest sensilla in rows near dorsal and ventral face. Tibiae slightly longer than femora and 1.4 - 1.6 times as long as tarsi, apically and basally narrowed; pro- and mesotibia broadest closely posterior to middle, metatibia broadest approximately



FIGS 21-25

Spalacosostea loebli sp.n.: 21, pronotum of female, dorsal view; 22, ventral view; 23, meso- and metasternum, male; 24, female, lateral view, head and prothorax removed; 25, meso-, metasternum and abdomen, female.

in middle; cleaning and smoothing fringe (SPANGLER & PERKINS 1989) absent; all tibiae with several types of hair-like sensilla in more or less regular longitudinal rows and few peg-like sharply tipped sensilla (Figs 46, 47). Tarsal formula 4-4-4; tarsal segments with few hair-like sensilla (Figs 41, 42, 57 - 59); claws moderately long, narrow, microreticulate; empodium without seta.

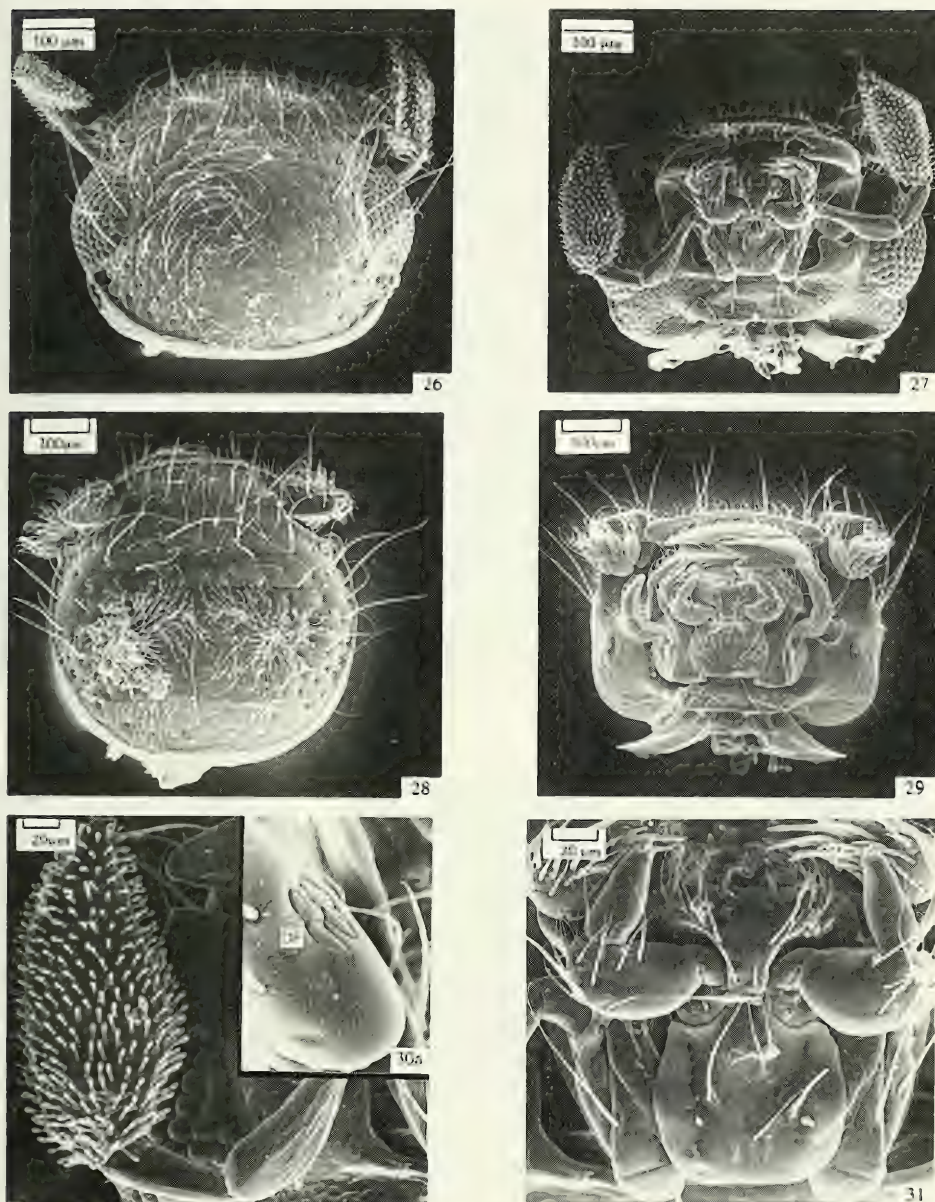
Abdomen with five slightly convex ventrites (Fig. 32), first two connate but separated by a distinct suture; ventrites 2, 3 and 4 about equally long; all with distinct laterosternites (KASAP & CROWSON 1975); intercoxal process about 1.25 times as long as wide (ML/MW). Tergites 2 - 7 with paired submedian fields of very short, densely arranged setae; tergite 7 bears posterior row of hair-like sensilla; pygidium with numerous hair-like sensilla. Seven pairs of functional spiracles situated in pleural membrane; spiracle 1 (Fig. 34) bears largest spiracular opening and filter apparatus with short spinules; spiracles 2 - 7 with shallow atrium, circular spiracular opening, prominent dorsal subatrial apodeme (RICHTER, 1969), short and bulbous ventral apodeme. Terminalia of all examined specimens only weakly sclerotized and hardly traceable, but similar to those in other dryopids. Aedeagus (Figs 43 - 45, 60 - 65) of trilobate type; penis long and slender, slightly curved, tapering apically; baso-lateral penile apophyses short; ejaculatory ducts inconspicuous; ventral membranous sac without sclerotized fibula. Parameres long, curved, tapering apically; phallobasis tubular.

Description ♀: Body form ovoid (Figs 33, 50), convex dorsally; body about 2 times as long as wide (LPE/MW); length (LPE) 1.30 - 1.70 mm.

Vestiture similar to those in males but sensilla longer and their sockets (mainly of TL and TM type) slightly deeper and broader.

Eyes vestigial (Figs 4, 5) and restricted to a small triangular field lying ventrally to cranial ridge. Labrum and mandible similar to those in male but mandible with rather convex sharp incisor edge. Maxillary palps only 0.4 times as long as MW of head, four-segmented (Figs 12, 13); segment 1 tiny; segment 2 longer, apically expanded; segment 3 slightly shorter than preceding; segment 2 and 3 with hair-like sensilla; terminal segment nearly conical, usually slightly longer than combined length of preceding segments and bearing: (1) apical sensillar cluster with several short, peg-like bluntly tipped sensilla, few short conical bluntly tipped pegs and one subterminal flattened peg-like and partly sunken sensillum; (2) basal sensillar cluster with several digitiform (**DF**) sensilla (Fig. 30b) and a round microdepression; (3) several hair-like sensilla (Figs 12, 13). Labium similar to that in male, but mentum shorter and broader (Figs 17, 29) with greater number of sensilla.

Pronotum convex dorsally, with feeble lateral longitudinal impressions; lateral margins basally more explanate and apically more arched than in male (Fig. 21); prosternal intercoxal process about 2.0 times as long as wide, medially slightly elevated (Fig. 22). Mesothorax as in male, but metasternum only about as long as mesosternum, without longitudinal and transverse sutures; almost entire surface of metasternum with deep macropunctures (Fig. 25); metepisterna weakly sclerotized and concealed by elytra (Fig. 24). Metanotum membranous (except for anterior margin of scuta) and not divided into distinct sclerites. Metendosternite (Fig. 48) Y-shaped, well sclerotized and its stalk about as long as arms, anterior tendons absent.



FIGS 26-31

Spalacosostea pselaphoides sp.n.: 26 head of male, dorsal view; 27, ventral view; 28, head of female, dorsal view; 29, ventral view; 30, maxillary palpus, male; 30a, basal portion of terminal segment of maxillary palpus, female; 31, labium of female.

Elytra (Figs 24, 33) suboval, about 1.4 times as long as their combined width; convex dorsally in cross section, strongly deflexed laterally; explanate lateral margin invisible in dorsal view; humeri not prominent; apices acute, strongly deflexed. Strial punctures large, dense, deeply impressed; unpaired strial intervals with rows of sensilla (TL); paired intervals with a single row of sensilla (TS). Ventral elytral flange, "rubbing patch" and metathoracic wings absent.

Legs (Fig. 24) in all parts shorter and broader than those in males but sensillar distribution similar.

Abdomen (Figs 24, 25) with ventrites similar to those in male, except for ventrite 5 bearing distinct apical shallow emargination, and tergites 2 - 7 lacking fields of short setae. Terminalia similar as in other dryopids (Lawrence, 1988): ovipositor (slightly longer than abdomen) consisting from laterally compressed coxites without styli; vaginal bursa without spines and sclerotized plates.

Habitat: specimens were collected by sifting vegetation debris mainly in primary *Lithocarpus* - *Castanopsis* and Dipterocarp forests.

***Spalacosostea loebli* sp.nov.**

(Figs 1-25, 39-48)

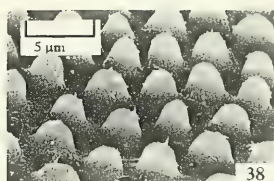
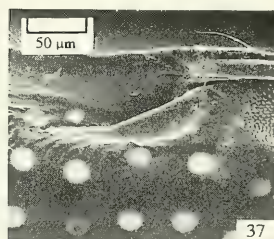
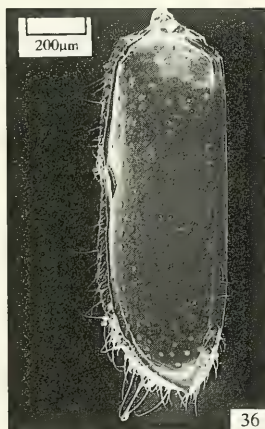
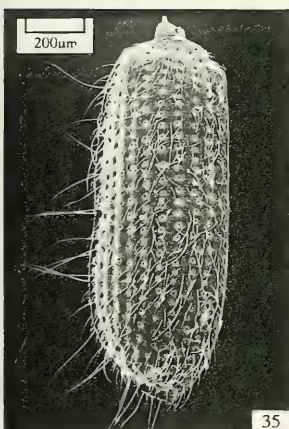
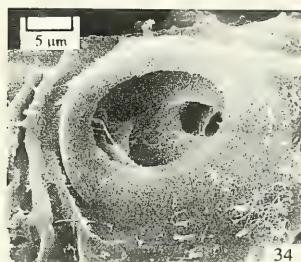
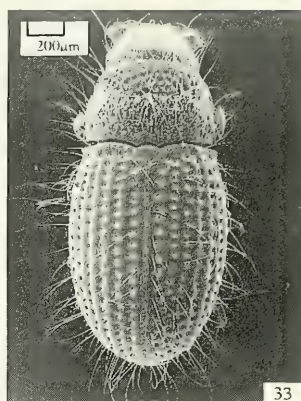
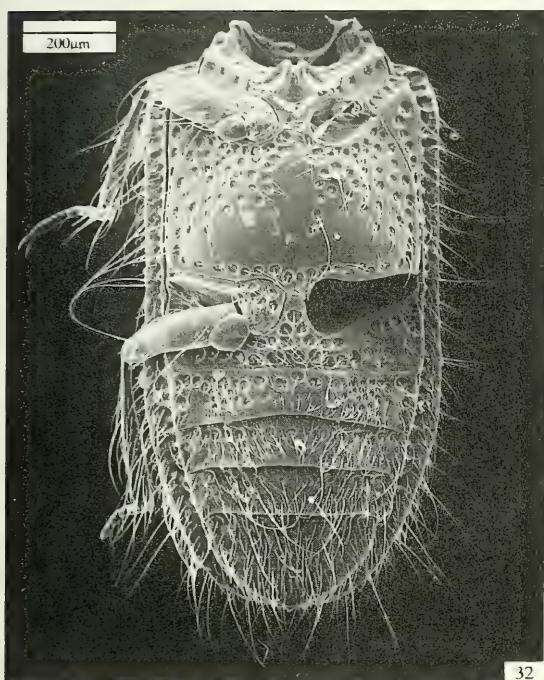
Etymology: this species is dedicated to my friend Ivan Löbl, who collected numerous new species of terrestrial dryopids during several expeditions to Southeast Asia.

Material examined: Holotype ♂: "SABAH: Poring Hot Springs, 500 m, 7. V. 1987 #15a Burckhardt - Löbl" MHNG; Paratypes: 1 ♂, 4 ♀♀ with the same data as holotype, MHNG; 2♂♂, 13♀♀: same data but 6. V. 1987. MHNG; 1 ♂, 1 ♀: same data but 11. V. 1987, MHNG; 1 ♂, 6 ♀♀: same data but 13. V. 1987, MHNG; 1 ♂, 6 ♀♀: same data but 550 - 600 m, 9. V. 1987, MHNG; 4 ♂♂, 11 ♀♀: same data but 600 m, nr Bat Cave, 10.V. 1987, MHNG; 10 ♂♂, 31 ♀♀: Borneo, Sabah, Mount Kinabalu National Park, Poring Hot Springs, area Kipungit Crk. 2, 14. - 30. VIII. 1988, A. Smetana lgt., MHNG, CKB; 1 ♂, 30 ♀♀: "SABAH: Crocker Ra. 1600m, km 51 rte Kota Kinabalu-Tambunan, 18.V. 87 Burckhardt - Löbl 30a" MNHG, CKB; 2 ♂♂, 4 ♀♀: "SABAH: E Mt. Kinabalu 1150m, rte Ranau-Kota Kinabalu, 24. V. 1987 Burckhardt - Löbl 40" MNHG; 1 ♀: "SABAH: Crocker Ra. 1200m, km 63 rte Kota Kinabalu-Tambunan, 19. V. 87 Burckhardt - Löbl 31a" MNHG; 5 ♀♀: "SABAH: Crocker Ra. 1270m, km 60 rte Kota Kinabalu-Tambunan, 17. V. 87 Burckhardt - Löbl 29a" MNHG.

Description of ♂ from the type locality (#15a): length (LPE) 1.20 - 1.36 mm ($\bar{O} = 1.28 \pm 0.05$, $n = 16$), maximum width 0.52 - 0.56 mm ($\bar{O} = 0.54 \pm 0.02$, $n = 16$).

Cranial macropunctures very fine, their diameter distinctly shorter than facet diameter; eyes large (Fig. 2), HW = 0.42 - 0.49 mm ($\bar{O} = 0.44 \pm 0.02$, $n = 16$), OI= 1.57 - 1.88 ($\bar{O} = 1.75 \pm 0.07$, $n = 16$). Each flagellar antennomere with two dendritic sensilla (D); antennomere 6 characterised by insertion of three sensilla P3, two sensilla P4 and one sensillum P5 (Figs 3, 6, 7). Maxillary palps with segment 3 about 1.9 times as long as wide (Fig. 11); terminal segment bearing basal cluster of sensilla. Mentum broader than long (MW/ML= about 1.5), microreticulated (Fig. 16). Labial palps with short hair-like sensilla on segment 2 arranged in one more or less distinct row (Fig. 16), one or two sensilla sometimes inserted more basally; microreticulation on segment 2 present internally.

Pronotum 0.45 - 0.54 mm ($\bar{O} = 0.51 \pm 0.02$, $n = 16$) wide (MW), usually widest at basal fifth; lateral margin almost straight (Fig. 19); diameter of macropunctures



FIGS 32-38

Spalacosostea pselaphoides sp.n.: 32, male, ventral view, head and pronotum removed; 33, female; 34, first abdominal spiracle, male; 35, elytra of male, dorsal view; 36, ventral view; 37, elytral flange, male; 38, rubbing patch, male.

distinctly shorter than facet diameter, macropunctures separated by a distance of about 1 - 3 facet diameters; punctures becoming sparser near anterior and posterior margins and larger laterally. Metasternum with short, indistinct median longitudinal impression (Fig. 23), glabrous area irregular (Fig. 23).

Elytra 1.76 - 2.08 ($\bar{O} = 1.85 \pm 0.08$, $n = 16$) times as long as their combined width; stria punctures separated by a distance slightly smaller than their diameter; stria intervals dorsally slightly wider than diameter of one stria puncture, becoming smaller toward lateral margin.

Protibia (Fig. 46) about 1.45 times as long as protarsus; ratio (ML/MW) of tarsal segment 4 (Figs 41, 42): of protarsus about 4.0, of mesotarsus about 4.4 and of metatarsus about 4.7 (all measured in lateral view). Claws approximately 0.5 times as long as length of terminal tarsal segments.

Ventrites 1 and 2 with irregularly distributed macropunctures, ventrites 3 - 4 without or only with very few macropunctures; ventrite 5 always lacking macropunctures. Aedeagus (Figs 43, 44) with parameres about as long as phallobasis (lateral view).

Description of ♀ from the type locality (#15a): length (LPE) 1.26 - 1.46 mm ($\bar{O} = 1.39 \pm 0.04$, $n = 43$), maximum width 0.64 - 0.70 mm ($\bar{O} = 0.67 \pm 0.02$, $n = 43$).

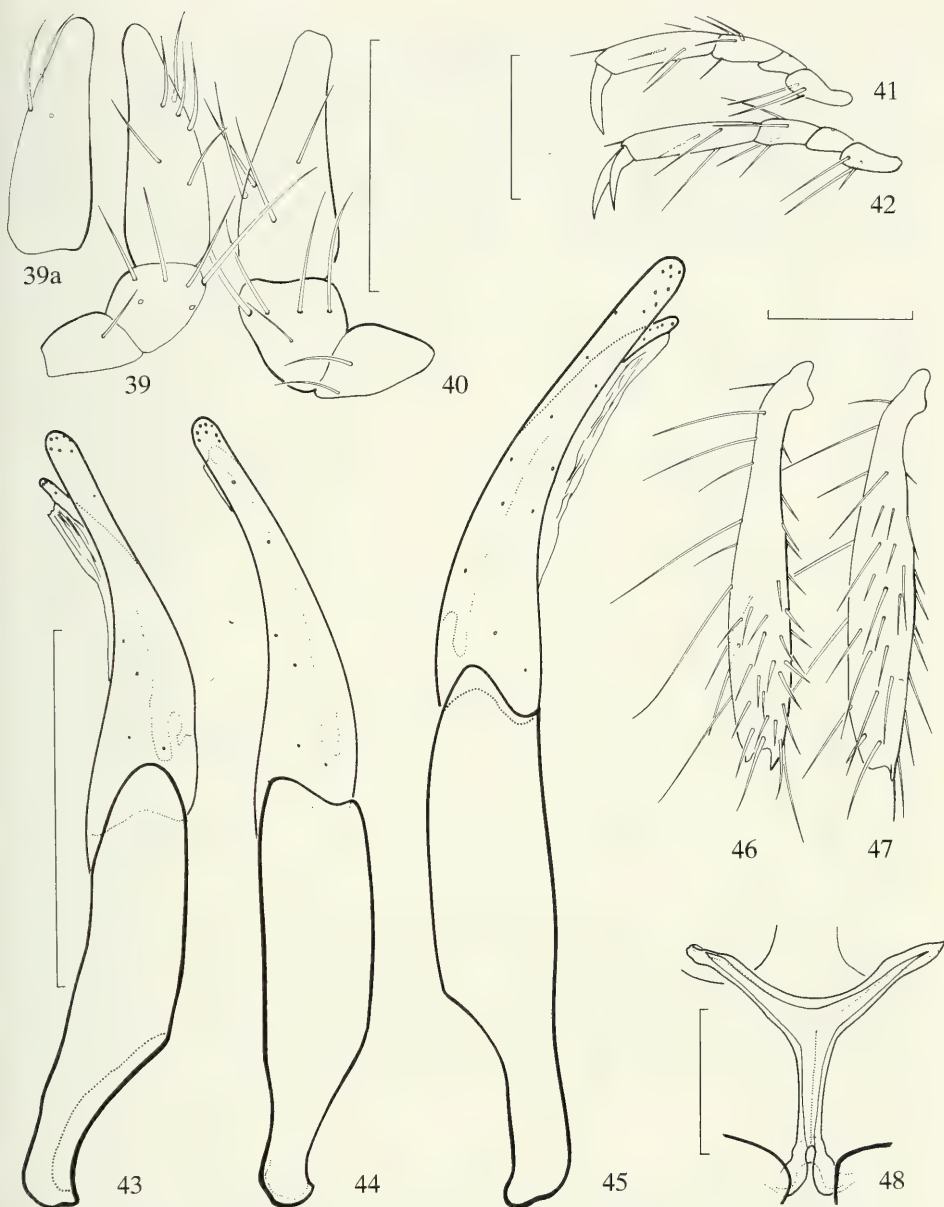
Cranial macropunctures distinctly larger than those in males, sensilla (TS) situated on vertex directed mesally. Antennal segment 6 without sensilla P3. Maxillary palps (Figs 4, 12, 13) with segments 2 and 3 approximately of same length, terminal segment 2.6 - 2.8 times as long as preceding, with 3 - 6 hair-like sensilla and a cluster of digitiform sensilla (DF) approximately in basal 0.2. Mentum (Fig. 17) about 1.5 times as wide as long (MW/ML), with microreticulation; labial palps as in Fig. 17.

Pronotum 0.57 - 0.66 mm ($\bar{O} = 0.61 \pm 0.02$, $n = 43$) wide (MW), widest at basal third; lateral margin moderately arcuate (Fig. 21), macropunctures slightly larger than those on cranium and separated usually by a distance equal or slightly longer than their diameter. Glabrous area of metasternum very small (Fig. 25).

Elytra 1.36 - 1.58 ($\bar{O} = 1.46 \pm 0.05$, $n = 43$) times as long as their combined width; interstices more convex than in male.

Ratio (ML/MW) of tarsal segment 4: of protarsus about 2.5, of mesotarsus about 2.6 and of metatarsus about 2.8; claws shorter, broader and more curved than those in males.

Variation: Size and morphometric indexes see in Tables 1, 2. Both sexes are larger in higher altitudes; the aedeagi from these localities are also larger but their proportions are similar to those in males from lower altitudes (see Figs 43 - 45). Females exhibit minor variations also in number and distribution of sensilla on mentum, terminal segments of maxillary palps (Figs. 39, 39 a, 40) and segment 2 of labial palps.



FIGS 39-48

Spalacosostea loebli sp.n.: 39a, terminal segment of left maxillary palpus, female from # 15a; 39, right maxillary palpus of the same female, basal segment removed; 40, female from # 40; 41, protarsus, male; 42, metatarsus, male; 43, 44 aedeagi of paratypes from # 15a, lateral view; 45, paratype from # 40; 46, protibia, male; 47, metatibia, male; 48, metendosternite, female. The scale bar represent 0.1 mm.

TABLE 1
Morphometrical characteristics of males *S. loebli* sp.n.

locality	n	LPE[mm]	MW of elytra	EI	MW of pronotum [mm]	HW [mm]	OI
30a	1	1.60	0.80	1.56	0.62	0.50	1.42
40	2	1.60	0.70, 0.72	1.66, 1.78	0.60, 0.65	0.50, 0.54	1.48, 1.42

TABLE 2
Morphometrical characteristics of females *S. loebli* sp.n.

locality	n	LPE [mm]	MW of elytra [mm]	EI	MW of pronotum [mm]
29a	4	1.45 - 1.54 $\bar{O}= 1.48 \pm 0.04$	0.70 - 0.84 $\bar{O}= 0.76 \pm 0.06$	1.39 - 1.56 $\bar{O}= 1.43 \pm 0.13$	0.63 - 0.70 $\bar{O}= 0.65 \pm 0.03$
30a	27	1.60 - 1.78 $\bar{O}= 1.67 \pm 0.05$	0.77 - 0.84 $\bar{O}= 0.81 \pm 0.02$	1.37 - 1.60 $\bar{O}= 1.47 \pm 0.06$	0.69 - 0.76 $\bar{O}= 0.72 \pm 0.02$
31a	1	1.53	0.76	1.42	0.67
40	4	1.49 - 1.66 $\bar{O}= 1.59 \pm 0.07$	0.73 - 0.80 $\bar{O}= 0.77 \pm 0.03$	1.45 - 1.53 $\bar{O}= 1.50 \pm 0.04$	0.67 - 0.70 $\bar{O}= 0.69 \pm 0.01$

Spalacosostea pselaphoides sp.n.

(Figs 26-38, 49-65)

Etymology: from *Pselaphus* in reference to the unusual large maxillary palpi as in many pselaphids.

Material examined: Holotype ♂: "SUMATRA: Jambi Mt. Kerinci, 1750 - 1850 m, 11. - 12. XI. 1989, Agosti, Löbl, Burckhardt # 11" MHNG; Paratypes: 4 ♂♂, 47 ♀♀ with the same data as holotype, MHNG, CKB; 1 ♂, 7 ♀♀: "SUMATRA: Jambi Mt. Kerinci, 1900 m, 13. XI. 1989, # 15a" MHNG, CKB; 2 ♀♀: "SUMATRA: Jambi W Mt. Tujuh Lake 1400 m, 14. XI. 1989, # 17" MHNG; 3 ♀♀: "SUMATRA: W Sum. Lubuksulasih, 30 km E Padang, 1100 m, 8. XI. 1989, # 7" MHNG; 2 u, 9 ♀♀: "SUMATRA: W Sum. # 21, Palopo Nat. Res. N. Bukittinggi, 900 m, 18 - 20. XI. 1989" MHNG; 1 ♂: "SUMATRA: W Sum. 5 km SE Payakumbuh, 600 m, 20 - 21. XI. 1989, # 24" MHNG; 3 ♂♂, 6 ♀♀: "SUMATRA: Aceh # 25a Mt. Leuser NP, 300 - 500 m, Ketambe, 23 - 30. XI. 1989" MHNG. All Agosti, Löbl, Burckhardt leg.

Description of ♂ from the type locality (# 11): Habitus (Fig. 49), length (LPE) 1.54 - 1.58 mm ($\bar{O}= 1.56 \pm 0.01$, n= 5), maximum width 0.65 - 0.67 mm ($\bar{O}= 0.66 \pm 0.01$, n= 5).

Cranial macropunctures with diameter about equal to facet diameter, separated by a distance of about 1 - 3 facet diameters (Fig. 26). Central area of vertex with more or less distinct cluster of sensilla TS with apices directed centrally. Eyes moderately large, HW = 0.43 - 0.47 mm ($\bar{O}= 0.45 \pm 0.01$, n= 5), OI= 1.36 - 1.41 ($\bar{O}= 1.38 \pm 0.18$, n= 5). Each flagellar antennomere with one dendritic sensillum (D); antennomere 6

characterised by insertion of two sensilla P3 laterally to sensillum S2 and by absence from sensilla type P4 and P5 (Fig. 51). Maxillary palps with segment 3 about 2.5 times as long as wide (Figs 27, 30); terminal segment without basal external cluster of sensilla. Mentum about as long as wide, without microreticulation (Fig. 31), on each posterior angle one short peg-like sensillum. Labial palps with short hair-like sensilla on segment 2 in two more or less distinct rows (Fig. 31); microreticulation absent.

Pronotum 0.56 - 0.58 mm ($\bar{O} = 0.57 \pm 0.01$, $n = 5$) wide (MW), widest at base; lateral margin almost straight; diameter of macropunctures slightly longer than facet diameter, macropunctures separated by distance about equal their diameter; punctures becoming smaller and sparser near anterior and posterior margins; surface with numerous recumbent sensilla (TS) except for a small area along anterior margin. Metasternum without median longitudinal impression, glabrous area approximately triangular (Fig. 32).

Elytra 1.83 - 1.97 ($\bar{O} = 1.88 \pm 0.06$, $n = 5$) times as long as their combined width; stria punctures separated by a distance distinctly smaller than their diameter; stria intervals dorsally about as wide as diameter of one stria puncture.

Protibia (Fig. 58) about 1.6 times as long as protarsus; ratio (ML/MW) of tarsal segment 4 (Figs 57 - 59): of protarsus about 3.0, of mesotarsus about 3.7 and of metatarsus about 4.0. Claws approximately 0.5 times as long as length of terminal tarsal segments.

Ventrites 1 and 2 with equally distributed macropunctures, ventrites 3 and 4 with macropunctures restricted onto anterior half; ventrite 5 with macropunctures near anterior margin. Aedeagus (Figs 60, 61) with short phallobasis; parameres about 1.3 times as long as phallobasis (lateral view), bluntly tipped, moderately bent ventrally (lateral view).

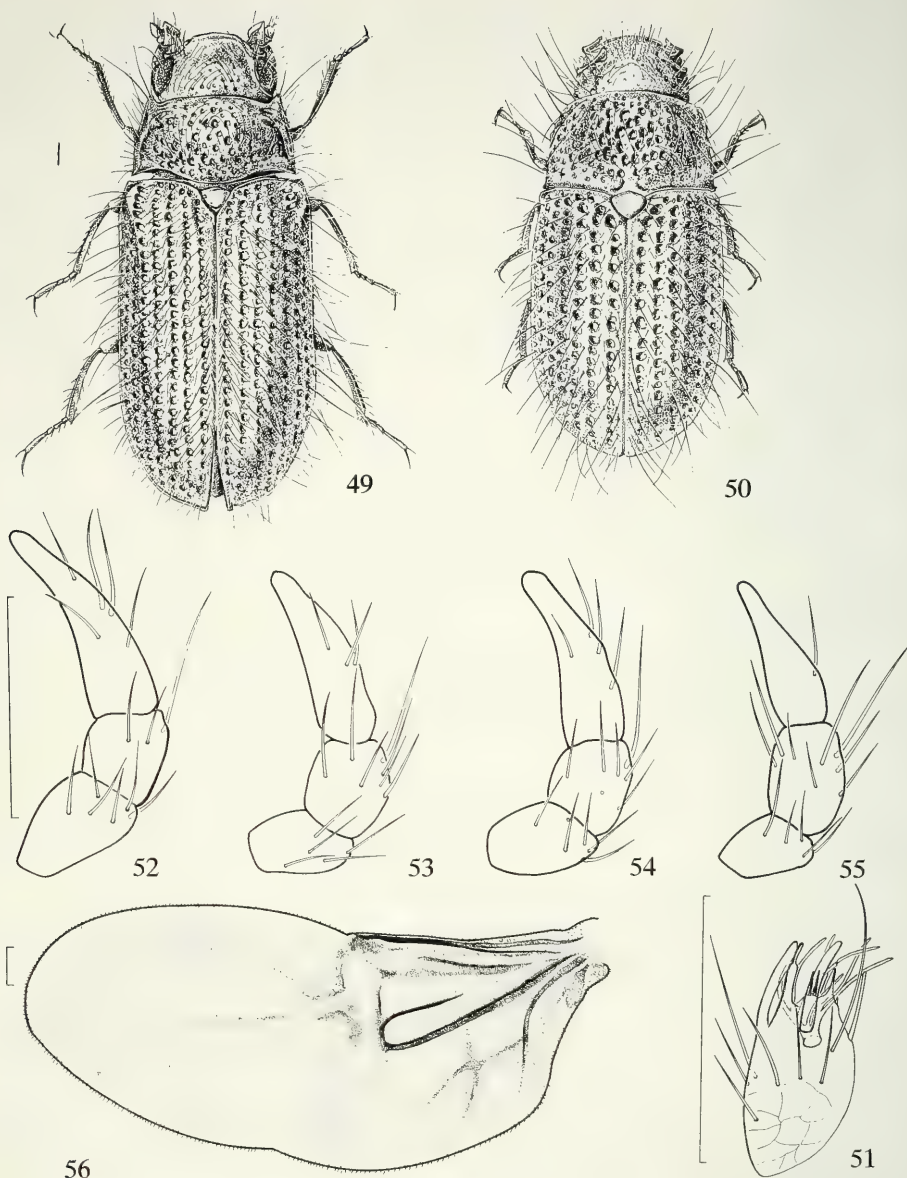
Description of ♀ from the type locality (# 11): Habitus (Fig. 50), length (LPE) 1.40 - 1.67 mm ($\bar{O} = 1.57 \pm 0.08$, $n = 30$), maximum width 0.69 - 0.83 mm ($\bar{O} = 0.78 \pm 0.03$, $n = 30$).

Vertex with numerous sensilla TS with apices directed to two sublateral points and form distinct clusters (Fig. 28). Antennomere 6 bearing, in addition to sensilla in male, one sensillum P5. Maxillary palps with segment 2 distinctly longer than segment 3, latter about as long as wide; terminal segment about 2.8 times as long as preceding, bearing 5 - 7 hair-like sensilla and a cluster of digitiform sensilla (DF) situated in basal 0.2 (Fig. 30a). Mentum about 1.4 times as wide as long (MW/ML), glabrous; labial palps as in Fig. 29.

Pronotum 0.63 - 0.71 mm ($\bar{O} = 0.66 \pm 0.03$, $n = 30$) wide (MW), widest at basal third; lateral margin slightly arched; macropunctures coarse except those near anterior and posterior margin, separated usually by a distance smaller than their diameter, sometimes confluent.

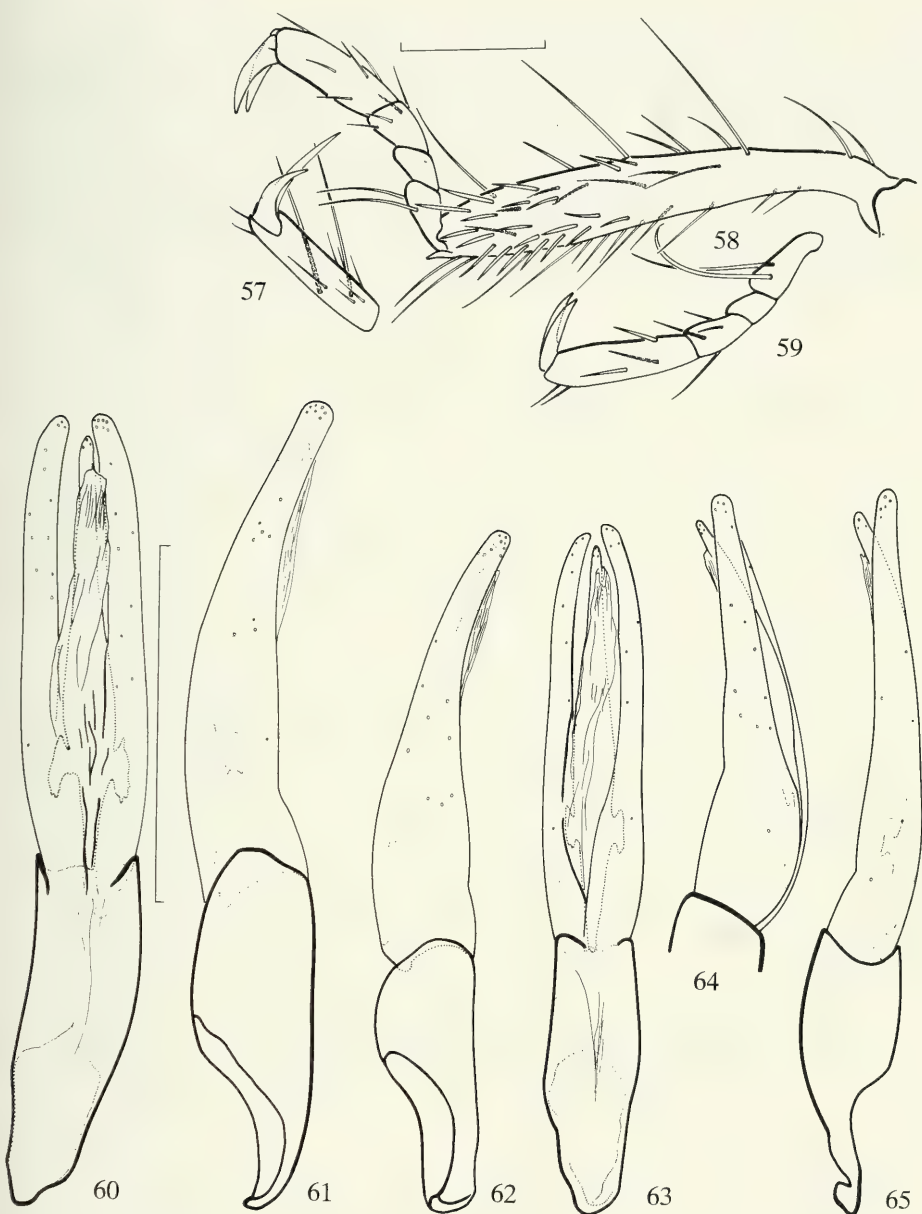
Elytra 1.41 - 1.59 ($\bar{O} = 1.47 \pm 0.06$, $n = 30$) times as long as their combined width.

Ratio (ML/MW) of tarsal segment 4: of protarsus about 2.2, of mesotarsus about 2.4 and of metatarsus about 3.3; claws shorter, broader and more curved than those in males.



FIGS 49-56

Spalacosostea pselaphoides sp.n.: 49, male; 50, female; 51, terminal antennomere of female; 52, maxillary palps of females from #11, basal segment removed; 53, from #25a; 54, from #21; 55, from #7; 56, metathoracic wing. The scale bar represent 0.1 mm.



FIGS 57-65

Spalacosostea pselaphoides sp.n.: 57, segment 4 of metatarsus, male; 58, protibia and protarsus, male; 59, mesotarsus, male; 60, aedeagus of paratype from #11, ventral view; 61, lateral view; 62, aedeagus of paratype from #21, lateral view; 63, ventral view; 64, 65, aedeagi of paratypes from #25a, lateral view. The scale bar represent 0.1 mm.

Variation: The specimens exhibit a moderate degree of variation in size, density of cranial and pronotal punctation as well as in morphometric indexes as shown in the Tables 3 and 4. The males vary moderately in the ratio of the parameral length to the phallobasal length, and in the shape of the paramere (see Figs 60 - 65); the specimens from lower altitudes are generally shorter and narrower with rather parallel-sided pronotum. The segments 2 - 4 of the maxillary palps and the segment 2 of the females labial palps exhibit differences in the shape, length and distribution of the sensilla (Figs 52 - 55). The eventual taxonomic significance of these variations is not understand. However, they indicate possibly only subpopulational isolation.

TABLE 3
Morphometrical characteristics of males *S. pselaphoides* sp.n.

locality	n	LPE[mm]	MW of elytra [mm]	EI	MW of pro- notum [mm]	HW [mm]	OI
#15a	1	1.58	0.67	1.89	0.58	0.47	1.37
#21	2	1.21	0.54	1.76	0.47	0.40 - 0.41	1.46 - 1.64
#24	1	1.18	0.52	1.79	0.43	0.38	1.75
#25a	3	1.25 - 1.27	0.58	1.65 - 1.71	0.51	0.41 - 0.45	1.53 - 1.60

TABLE 4
Morphometrical characteristics of females *S. pselaphoides* sp.n.

locality	n	LPE[mm]	MW of elytra [mm]	EI	MW of pro- notum [mm]
# 7	1	1.38	0.67	1.48	0.58
# 15 a	5	1.51 - 1.74 Ø= 1.63 ± 0.11	0.74 - 0.84 Ø= 0.81 ± 0.04	1.44 - 1.54 Ø= 1.48 ± 0.04	0.65 - 0.76 Ø= 0.70 ± 0.04
#17	2	1.69 - 1.70	0.81 - 0.83	1.51 - 1.52	0.70
# 21	8	1.30 - 1.41 Ø= 1.35 ± 0.03	0.63 - 0.69 Ø= 0.66 ± 0.02	1.47 - 1.57 Ø= 1.52 ± 0.03	0.56 - 0.60 Ø= 0.58 ± 0.01
# 25 a	6	1.30 - 1.52 Ø= 1.42 ± 0.07	0.72 - 0.76 Ø= 0.74 ± 0.01	1.32 - 1.51 Ø= 1.37 ± 0.07	0.63 - 0.69 Ø= 0.67 ± 0.02

KEY TO THE SPECIES OF *Spalacosostea*

- 1 Body form elongate (Fig. 49); eyes large, well developed (Fig. 1); maxillary palps about as long as MW of head, with terminal segment robust, expanded (Fig. 11); humeri prominent (Fig. 35), metathoracic wings present; metasternum distinctly longer than mesosternum (Fig. 23). ♂♂ 2
- Body form ovoid (Fig. 33); eyes vestigial, reduced to a very small triangular field (Fig. 5); maxillary palps 0.4 times as long as MW of head, with terminal segment nearly conical (Figs 4, 12, 13); humeri not prominent; metathoracic wings absent; metasternum about as long as mesosternum (Fig. 25). ♀♀ 3
- 2 Cranial and pronotal macropunctures very fine (Fig. 19), with diameters distinctly shorter than facet diameters; each flagellar antennomere with two dendritic sensilla (D) (Figs 3, 6, 7); segment 3 of maxillary palps about 1.9 times as long as wide (Fig. 11); mentum about 1.4 times as wide as long, microreticulated (Fig. 16); segment 2 of labial palps with one row of short hair-like sensilla (Fig. 16); ventrites 3 - 4 without or only with very few macropunctures, ventrite 5 without macropunctures; parameres and phallobasis about equally long (Figs 43 - 45).
. *S. loebli* sp.n.
- Cranial macropunctures coarse, with diameter about equal to facet diameter (Fig. 26), pronotal macropunctures with diameter slightly longer than facet diameter (Fig. 49); each flagellar antennomere with one dendritic sensillum (D) (Fig. 51); segment 3 of maxillary palps about 2.5 as long as wide (Figs 27, 30); mentum as long as wide, glabrous (Fig. 31); segment 2 of labial palps with short hair-like sensilla arranged in two more or less distinct rows (Fig. 31); ventrites 3 - 4 with macropunctures in anterior half, ventrite 5 with macropunctures near anterior margin (Fig. 32); parameres about 1.3 times as long as phallobasis (Figs 60 - 65). *S. pselaphoides* sp.n.
- 3 Cranial and pronotal macropunctures very fine (Fig. 21); each flagellar antennomere with two dendritic sensilla (D); mentum microreticulated (Fig. 4, 17); segment 2 of labial palps with one row of short hair-like sensilla (Fig. 17); ventrite 3 - 4 without or only with very few macropunctures, ventrite 5 without macropunctures (Figs 24, 25).
. *S. loebli* sp.nov.
- Cranial and pronotal macropunctures coarse (Figs 28, 50); each flagellar antennomere with one dendritic sensillum (D); mentum glabrous (Fig. 29); segment 2 of labial palps with two rows of short hair-like sensilla; ventrite 3 - 4 with macropunctures in anterior half, ventrite 5 with macropunctures near anterior margin.
. *S. pselaphoides* sp.n.

DISCUSSION

Spalacosostea shares the lack of the 2-nd cubito-anal cells with *Quadryops* and genus B, and the four-segmented tarsi with *Quadryops*. *Sosteamorphus*, *Protoparnus*, *Oreoparnus* and genus A lack metathoracic wings. The number of antennomeres is reduced in genus A to nine.

Spalacosostea, *Guaranius*, *Sosteamorphus*, genus A, *Quadryops*, *Sosteamorphus*, *Oreoparnus* and *Protoparnus* share the presence of dendritic sensilla on the flagellar antennomeres. These sensilla are variable in branching, and they are present also in some aquatic taxa. Their ultrastructural features and physiological functions are unknown.

Protoparnus, *Oreoparnus*, and genera A and B have lateral pronotal ridges while they are absent in *Sostea*, *Sosteamorphus*, *Geoparnus* and *Spalacosostea*.

In absence of detailed information on the morphology of *Holcodryops*, *Quadryops*, and genus B, all but the last known only as the single type specimen (SPANGLER 1987), the relationship of *Spalacosostea* (as other relationships within the family) remain unknown. However, no synapomorphy indicates close relationship of *Spalacosostea* with any other sympatric terrestrial group of the dryopids (*Geoparnus*, *Sostea*).

ACKNOWLEDGEMENTS

I am especially indebted to I. Löbl (MHNG), M. A. Jäch (NMW), S. Endrödy-Younga (TMP), N. Berti (MNHP), E. De Boise (BMNH) and P. Lindskog (RMS) for the material used in this study. Special thanks are due to J. Wüest (MHNG) and J. Kozánková for SEM photographs and K. Majer for the habitus drawing of *Spalacosostea pselaphoides*. M. A. Jäch, V. Kováč, R. Leschen, I. Löbl and W. D. Shepard critically commented the manuscript.

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A peculiar new species of *Anomotarus* (*Nototarus*) from New Guinea (Coleoptera, Carabidae, Lebiinae)

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A peculiar new species of *Anomotarus* (*Nototarus*) from New Guinea (Coleoptera, Carabidae, Lebiinae). - *Anomotarus* (*Nototarus*) *pilosus* sp. n. from Papua New Guinea is described. The species differs from all known Australian and New Guinean *Nototarus* by the conspicuous, erect pilosity of the dorsal surface, the multiplication of the anterior lateral pronotal setae, and the absence of any microreticulation on head, pronotum, and elytra.

Key-words: Coleoptera - Carabidae - Lebiinae - Genus *Anomotarus*, subgenus *Nototarus* - New species - New Guinea.

INTRODUCTION

While studying the numerous carabid material (ca. 3,000 specimens) collected by W. Ullrich in Papua New Guinea during 1979 and 1980 and stored in the Muséum d'histoire naturelle, Genève (MHNG), I discovered a single specimen of a peculiar new species that belongs to the subgenus *Nototarus* Chaudoir of the genus *Anomotarus* Chaudoir. The new species differs from all known species of that subgenus and also from those undescribed Australian species known to me by the peculiar erect pilosity of the surface, the multiplication of the anterior lateral pronotal setae, and the absence of any microreticulation on the upper surface. Due to its peculiar habitus the species is described, although a single specimen is only available.

Nototarus is an Australian subgenus of the more widely ranging Australian–Oriental genus *Anomotarus* Chaudoir combining characteristic, stout-built, flightless lebiine Carabidae of which thus far a single species was known outside from Australia proper, namely *Nototarus papua* Darlington from eastern Papua New Guinea.

Certainly the species of *Nototarus* are closely related to those of the Australian–Oriental subgenus *Anomotarus* Chaudoir s. str., but I am not sure, whether the current status of *Nototarus* as a subgenus of *Anomotarus* (BALL & HILCHIE 1983, MOORE *et al.* 1987) is justified. Perhaps a revision of both subgenera will clarify the taxonomic situation.

MEASUREMENTS

Measurements were made under a stereo microscope using an ocular micrometer. Length has been measured from tip of labrum to apex of elytra, hence, measurements may slightly differ from those of DARLINGTON (1968).

Anomotarus (*Nototarus* Chaudoir)

Nototarus CHAUDOIR, 1875: 19; DARLINGTON 1968: 185; BALL & HILCHIE 1983: 192; MOORE *et al.* 1987: 306.

Type species: *Nototarus australis* Chaudoir, 1875

KEY TO *Nototarus* spp. OCCURRING IN NEW GUINEA

- 1 Smaller species, length < 5.5 mm; surface without pilosity; only a single anterior lateral pronotal seta present *papua* Darlington
- Larger species, length > 6.5 mm; surface with distinct erect pilosity; 3 anterior lateral pronotal setae present *pilosus* sp. n.

Nototarus pilosus sp. n.

(Figs 1, 2)

Type material: Holotype ♂, Papua New Guinea: PNG/EHProv., surroundings of Kainantu Onerunka 24-IX-79, W.G. Ullrich (MHNG).

Diagnosis: Easily recognized and distinguished from all known species and from those undescribed species known to me by the not microreticulate, though pilose surface and the multiplication of the anterior lateral seta of the pronotum.

Description: Measurements: Length: 6.8 mm, width: 2.8 mm. Ratios: width pronotum/head: 1.21; width/length of pronotum: 1.18; width base/apex of pronotum: 0.95; length/width of elytra: 1.34; width elytra/pronotum: 1.44.

Colour: Upper and lower surfaces glossy black. Margins of labrum, palpi, antennae, and tibiae and tarsi dark reddish, femora blackish.

Head: Large and wide, neck short and very wide. Eyes small, though far more convex than in other species, distinctly protruding from head. Orbits as long as eyes, gently convex. Labrum large, anteriorly slightly concave. Mandibles comparatively elongate, evenly curved, apex very acute. Labial palpi widened, but less markedly securiform than in most other species of the subgenus. Mentum without distinct tooth. Antenna short and stout, just surpassing apex of pronotum, subapical antennomeres ovalish, c.1.2 x as long as wide. Frons near eyes with about 5 strong, markedly irregular ridges that reach to middle of eye, median part of frons narrowly smooth. Clypeus, frons, and neck with very coarse, sparse, somewhat confluent punctures and with rather sparse, erect pilosity. Labrum with distinct isodiametric microreticulation, rest of head without microreticulation, highly glossy.

Pronotum: Short and wide, with comparatively wide base, considerably wider than head. Disk fairly convex. Apex moderately excised, apical angles slightly

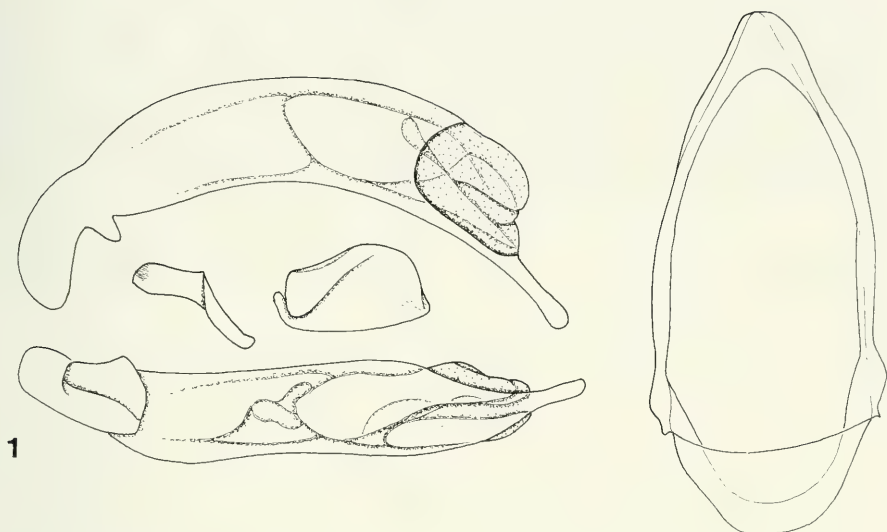


FIG. 1

Nototarus pilosus sp. n. Male genitalia. Genital ring, aedeagus, and parameres. Length of aedeagus: 1.85 mm.

protruding, though rounded off. Lateral border anteriorly strongly curved, deeply excised in front of basal angles, these acute, laterally distinctly protruding. Lateral parts of base very oblique. Apex unborded, lateral channel narrow, lateral margin not explanate, base bordered. Median line deep, touching apex, but ending shortly in front of base. Disk regularly convex, without distinct basal grooves. Posterior lateral seta at basal angle, three anterior lateral setae present in anterior half. Surface without any microreticulation, but with double. coarse and very fine puncturation, highly glossy, with erect pilosity, lateral margin with a fringe of elongate pilosity.

Elytra: Short and wide, upper surface rather convex, posteriorly considerably widened, but shoulders comparatively wide. Widest diameter in apical third. Shoulders projecting, though widely rounded off. Lateral border evenly convex, apex rather deeply sinuate, each elytron widely rounded at sutural angle. Striae deep, slightly punctulate. intervals rather convex, each interval with two irregular rows of very coarse punctures. Marginal setae elongate, raising from remarkably large umbilicate pores. No setiferous punctures visible on 3rd interval. Surface without microreticulation, highly glossy, with moderately dense, erect pilosity.

Lower surface: Without microreticulation, glossy, with rather sparse, erect pilosity. Metepisternum about quadrate. Abdominal sternites apparently without special tactile setae, terminal sternite in male near apical margin with one seta on either side.

Legs: Rather stout, surface of femora and tibiae fairly densely pilose. Claws with 3–4 rather elongate teeth. 1st–3rd tarsomeres of male protarsus biserially squamose on lower surface.

Male genitalia: Genital ring narrow and elongate, slightly asymmetric, with elongate basal plate. Aedeagus elongate, evenly curved, lower surface evenly concave. Apex elongate and narrow, slightly asymmetric, at the very tip slightly widened. Orificium short, slightly turned to left. Internal sac complicately coiled, though without any markedly sclerotized structures, though holotype with parts of a nematomorph worm in internal sac that appears as a sclerotized structure. Parameres (Fig. 1) relatively small, both with extremely fine pilosity in apical part, right paramere tiny, remarkably smaller than left.

Female genitalia: Unknown.

Etymology: The name refers to the conspicuous pilose surface.

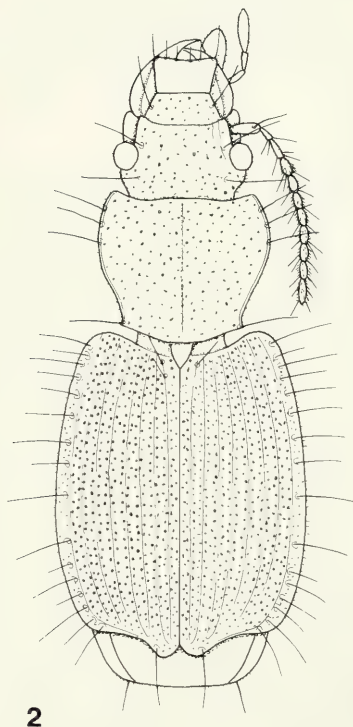


FIG. 2

Nototarus pilosus sp. n. Holotype. Length: 6.8 mm.

R e m a r k s : This is a very peculiar species that differs in many respects from the bulk of the Australian species of *Nototarus* as well as from *N. papua* Darlington and is perhaps a highly derived species. Main apomorphic characters are the stout built with wide and convex pronotum and elytra, massive head with small though remarkably protruding eyes, absence of microreticulation, presence of very coarse puncturation, presence of erect pilosity on upper surface, and multiplication of the anterior lateral setae of the pronotum. At the present state of knowledge this species is probably without any closer relative in Australia and New Guinea.

ACKNOWLEDGEMENTS

My thanks are due to Dr I. Löbl, Genève, who kindly submitted the specimen for examination, alongside with a great number of New Guinean carabids.

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Stigmale Plastronstrukturen, die einigen Diplopoden-Arten eine submerse Lebensweise in kaltem und in fließendem Wasser ermöglichen

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Stigmal plastron structures which enable some species of Diplopoda to live submersed in cold and running water. - The structure of stigmata and their microtrichia are being compared for the millipides *Polydesmus denticulatus*, *P. (Brachydesmus) superus* (Polydesmidae), *Oxidus gracilis*, *Selminosoma chapmani*, *Mestosoma hylaeicum* (Paradoxomatidae) and *Aphelidesmus* sp. (Platyrrhacidae). They enable plastron respiration under water. Flood tolerance is experimentally shown for *M. hylaeicum* and flood resistance for *P. denticulatus* and *P. (B.) superus*.

Key-words: Millipedes - Stigmata - Microtrichia - Plastron - Respiration - Flood tolerance - Flood resistance - Polydesmida - Diplopoda.

EINLEITUNG

Seit den Untersuchungen von MESSNER & ADIS (1988) weiß man, daß die juvenilen und subadulten Stadien des brasilianischen Diplopoden *Gonographis adisi* (Pyrgodesmidae) den jährlich wiederkehrenden Flutpuls des Amazonas submers langfristig überdauern, weil sie unter einer kutikulären Sekretschicht einen körperumfassenden, dünnen Luftfilm (= Plastron) zu halten vermögen, ähnlich wie es einige Milben mit ihrem Cerotegument können (MESSNER *et al.* 1992).

Inzwischen sind weitere Diplopoden-Arten bekannt geworden, die von kaltem Wasser überflutet, bis zu 75 Tage überleben können (ZULKA 1989, 1991, 1993) sowie in kaltem Höhlenwasser (HOFFMAN 1977/78) oder in schnell fließenden, flachgründigen Bächen langfristig oder gar permanent submers leben können (STAUDER 1990).

Da in keinem der o.g. Fälle eine funktionsmorphologische Untersuchung über die Diplopoden existiert, sollen erste rasterelektronenmikroskopische Ergebnisse dazu vorgelegt werden.

MATERIAL UND METHODEN

Adulti und Subadulti (Stad. VII: 16 Beinpaare) von *Polydesmus denticulatus* C.L. Koch, 1847 (Polydesmidae; Länge: 12-16 mm) und ein Männchen von *Polydesmus (Brachydesmus) superus* (Latzel, 1884) (Polydesmidae; Länge: 6,5-10 mm), waren in den Jahren 1986-1989 manuell oder in Barberfallen im WWF-Schutzgebiet Marchauen, nördlich von Marchegg (Österreich) von K.P. Zulka gefangen worden. Zur Messung der Überflutungstoleranz wurden 20 bzw. 10 Tiere einzeln in ein Plastikdöschen gesetzt, dessen Boden mit Sand ausgefüllt war. Das Döschen wurde mit Gaze geschlossen und mit Wasser von verschiedener Temperatur im Aquarium überflutet. Luftblasen in den Döschen wurden mit einer Pipette abgesaugt. Das Aquarium wurde mit einer Aquariumpumpe belüftet und umgewälzt. Die Döschen wurden alle 2 Tage kontrolliert. Der Versuch wurde für das jeweilige Tier als beendet gewertet, wenn es aufgequollen und damit bewegungsunfähig war.



ABB. 1

Polydesmus superus ♂, Stigmen auf dem 4. Körperring. 420:1, Foto: B. Messner.

Oxidus gracilis (Koch) (Paradoxomatidae; Länge 20-22 mm) wurde in einem schnell fließenden Bach (Fließgeschwindigkeit ca 0,5 m/s) auf der Insel Madeira unter Steinen gesammelt (STAUDER 1990) bzw. entstammt einer Aufsammlung von R.L. Hoffman (Martinsville/U.S.A.) aus Tifton (Georgia/U.S.A.).

Selminosoma chapmani Hoffman 1977/78 (Paradoxomatidae; max. Länge: 22,5 mm) stellte uns R. Hoffman aus der Aufsammlung von Herrn Chapman aus Tümpeln der Höhle Selminum Tem von Papua Neu Guinea zur Verfügung.

Der Aufsammlung von J. Adis aus dem Überschwemmungsgebiet des Amazonas-Solimões der Jahre 1982, 1987/88 und 1993 entstammen Adulti, Subadulti und Juvenile (Stadium VI: 15 Beinpaare) von *Mestosoma hylaeicum* Jeekel, 1963 (Paradoxomatidae; max. Länge: 32 mm) und *Aphelidesmus* sp. (Platyrhacidae; max. Länge: 40 mm). Beide Arten sind bei Hochwasser auf Baumstämmen über dem Wasserspiegel, *M. hylaeicum* sogar im Kronenraum zu finden, nicht aber submers (ADIS 1992; ADIS & MESSNER 1997).

Tauchversuche mit *M. hylaeicum* wurden von J. Adis in Aquarien bei verschiedenen Wassertemperaturen im Labor durchgeführt. Zur Ermittlung der maximalen Tauchzeit wurden die Tiere einzeln in aufklappbaren Metallgazesieben (Durch-



ABB. 2

Polydesmus superus ♂, vorderes Stigma und kolbenförmige Mikrotrichien des 5. Körperringes. 2850:1; Foto: B. Messner.

messer 5 bzw. 6 cm, Maschenweite 0,6 mm) in unbelüftetem bzw. belüftetem Wasser (Aquariumpumpe) abgetaucht. Die Überlebensrate der Versuchstiere wurde 48 Stunden nach Beendigung des jeweiligen Tauchversuches unter Haltungsbedingungen im Klimaschrank (24 °C, auf Erde) ermittelt.

Für die rasterelektronenmikroskopische Untersuchung wurden nur in Alkohol fixierte Tiere verwendet. Die zarteren subadulten bzw. juvenilen Tiere wurden kritisch-punktgetrocknet und die Adulti luftgetrocknet. Alle Tiere wurden mit Nagellack auf Metallblöcke geklebt und in Argon- bzw. Stickstoffatmosphäre mit Gold bedampft.

Die Untersuchung erfolgte mit dem Rasterelektronenmikroskop vom Typ Tesla 3000 (CSR) bzw. Zeiss Nanolab 7 im elektronen-mikroskopischen Laboratorium des Fachgebietes Biologie in Greifswald bzw. im Max-Planck-Institut für Limnologie in Plön.

ERGEBNISSE

Erste Lebendbeobachtungen an den heimischen Diplopoden *Polydesmus denticulatus* und *P. superus* von ZULKA (1991, 1993) sowie an der amazonischen Art *M. hylaeicum* von J. Adis (unveröff.) zeigten, daß allein die Stigmenöffnungen



ABB. 3

Oxidus gracilis, Stigmen des 4. Körperringes. 570:1; Foto: B. Messner.

hydrophob und damit in der Lage sind, eine Luftblase eine gewisse Zeit zu halten. Andere Strukturen auf den Tergitflächen, wie kutikuläre Pusteln oder wabenartige Vertiefungen, scheinen ohne Einfluß auf eine Plastronbildung zu sein.

Die Stigmen von *Polydesmus denticulatus* und *P. (B.) superus* befinden sich in einem von der oberen Sternitfläche leicht überwölbten Feld an dessen Basis, unmittelbar an den Coxen. Sie erheben sich halbkugelförmig aus der Fläche (Abb. 1). Nach EISENBEIS & WICHARD (1985) besteht die *ingesenkte* Artriumwand der Stigmenöffnung aus einem kultikulären Gitter oder Netz, dem aber noch kleine, kolbenförmige Mikrotrichien - relativ dicht stehend - aufgesetzt sind (Abb. 2).

Bei *Oxidus gracilis* sind die beiden Stigmen jedes Doppel-Segments unterschiedlich groß und von einem wulstigen Rand umgeben. Das große, vordere Stigma ist langoval. 2/3 seiner Fläche erhebt sich deutlich über das Coxalfeld und fällt mit einem weiteren Drittel zungenförmig nach craniad hin ab (Abb. 3). Das 2. Stigma ist kleiner und rund. In beiden ist die Atriumwand so weit nach oben *vorgewölbt*, daß eine schlitzförmige Öffnung, die in das Tracheensystem führt, übrigbleibt. Die vorgewölbte Atriumwand ist von dichtstehenden, borstenförmigen Mikrotrichien besetzt.

Die Stigmen des Höhlendiplopoden *Selminosoma chapmani* bezeichnete schon der Erstbeschreiber (HOFFMAN 1977/78) als auffallend große, halbkugelige Gebilde, die von einem Ringwall umgeben werden. Das erste Stigma jedes Segments ist

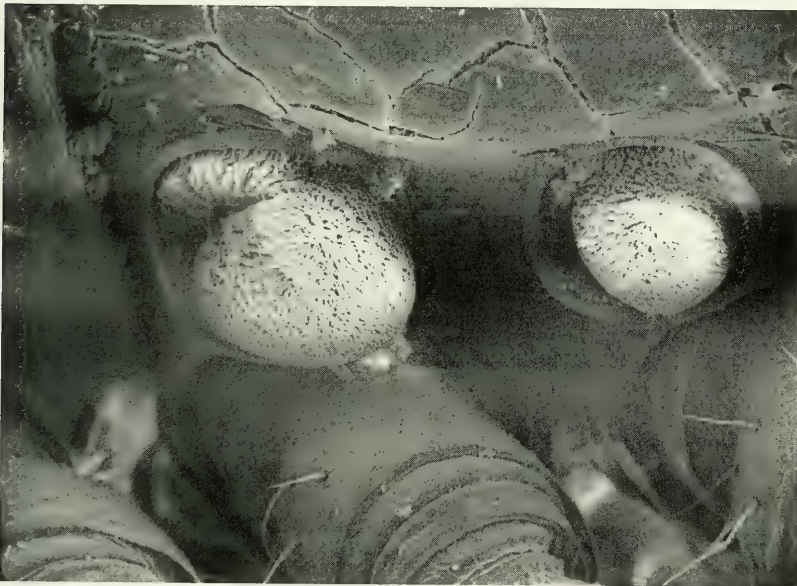


ABB. 4

Selminosoma chapmani, Stigmen des 3. Körperringes. 230: 1; Foto: B. Messner.

deutlich größer als das zweite. Die mit einem dichten Mikrotrichienfeld besetzte Atriumwand ist halbkugelförmig, weit über den Stigmenrand nach außen vorgewölbt und läßt nur noch einen nach craniad eingesenkten Stigmenschlitz erkennen (Abb. 4 & 5). Die borstenförmigen Mikrotrichien sind apikal vielspitzig aufgezipfelt, so daß der haarige Besatz noch dichter erscheint.



ABB. 5

Selminosoma chapmani, vorderes Stigma des 3. Körperringes. 570:1; Foto: B. Messner.

Die Ausbildung der Stigmen der beiden brasilianischen Diplopodenarten *Mestosoma hylaeicum* (Abb. 6) und *Aphelidesmus* sp. ist mit der von *Oxidus gracilis* und *Selminosoma chapmani* vergleichbar: die Stigmen werden in gleicher Weise von der Mikrotrichien tragenden Atriumwand bis auf einen craniaten Schlitz ausgefüllt; die Atriumwand wölbt sich deutlich - aber nicht so stark wie bei *Selminosoma chapmani* - über den wulstigen Stigmenrand. Die borstenförmigen Mikrotrichien von *Aphelidesmus* sp. sind in der Mehrzahl ein-, selten zweizipfelig (Abb. 7) und die von *Mestosoma hylaeicum* vielspitzig aufgezipfelt (Abb. 8).

DISKUSSION

Bei verschiedenen Tracheatengruppen (Diplopoden, Chilopoden und Insekten (Thysanoptera) besteht die Artriumwand der Stigmenöffnungen aus einem kutikulären Gitter oder filigranen Netz, dem noch kolben- oder pilzförmige Zapfen aufgesetzt sein können (ADIS & MESSNER 1997, ADIS, BARBIERI & MINELLI unveröff.,



ABB. 6

Mestosoma hylaeicum ♂, Stigmen auf dem 5. Körperring. 190:1; Foto: J. Adis.

EISENBEIS & WICHARD 1985, MORITZ 1985). Diesen kutikulären Sperrvorrichtungen wird in der Regel eine Schutzfunktion vor eindringenden Fremdkörpern, seltener vor eindringendem Wasser zugeschrieben (HOPKIN & READ 1992, MORITZ 1985).

Aber schon die Tauchexperimente mit den Diplopodenarten *Polydesmus denticulatus* und *P. (Brachydesmus) superus* in verschieden temperiertem Wasser machen deutlich, daß die mit kolbenförmigen Zapfen teilversperrten Stigmen in 4 bzw. 9 °C kaltem Wasser bereits eine Überflutungsresistenz von 50-75 Tagen ermöglichen (ZULKA 1991, 1993).

Je niedriger die Wassertemperatur, desto höher ist die O₂-Bindung, d.h. bei erniedrigtem Stoffwechsel und gleichzeitig erhöhtem O₂-Gehalt des Wassers kommt es zu einer deutlich verlängerten Tauchzeit:

Der amazonische Diplopode *Mestosoma hylaeicum*, der selbst nicht taucht, hat eine experimentelle Tauchtoleranz

ohne Belüftung von

6-8 Std. bei 25 °C (ca. 2,0 mg O₂/l), 12-18 Std. bei 20 °C (ca. 4,0 mg O₂/l), 42-48

Std. bei 15 °C (ca. 5,4 mg O₂/l)

und mit Belüftung von

24-26 Std. bei 25 °C (> 6,5 mg O₂/l), 48-72 Std. bei 20 °C (> 6,6 mg O₂/l), 144-168

Std. bei 15 °C (>7,9 mg O₂/l).

In die Gruppe der Diplopoden, die bei höheren Temperaturen ein Überfluten nur kurzzeitig, aber bei niederen Temperaturen langfristig tolerieren, gehören weiterhin die bisher nur atemphysiologisch untersuchten Arten *Rhinocricus padbergi* (PENTEADO & MENDES 1977, 1978), *Pachydesmus crassicutis* und *Oethoporus texicoleus* (STEWART & WOODRING 1973) sowie *Spirostrephus asthenes* (DWARAKANATH & JOB 1974; vgl. auch HOPKIN & READ 1992).

Wird nun die große Zahl von Stigmen wie bei *Oxidus gracilis* und *Selminosoma chapmani* durch eine mit Mikrotrichien besetzten und z. T. vorgewölbten Atriumwand zwar verengt, aber ihr Luftraum durch die wahrscheinlich hydrophoben (HOFFMAN 1977/78) Mikrotrichien nach außen hin als Plastron vergrößert, so ist submers eine größere Fläche für den Gasaustausch vorhanden und in fließendem Wasser sogar ein Luftblasenfang im Unterdruckbereich des angeströmten Tieres oder eines angeströmten Steines möglich (vgl. MESSNER *et al.* 1981, STRIDE 1953, 1958).

Diese funktionsmorphologische Gegebenheit einer plastronartigen Erweiterung der vielen stigmalen Flächen an einem Tier ergibt bei den Diplopodenarten *Oxidus gracilis* und *Selminosoma chapmani* eine positive Korrelation zu der zunächst unverstandenen Tauchfreudigkeit bzw. dem ungewöhnlichen submersen Aufenthaltsort dieser beiden Arten (HOFFMAN 1977/78, Stauder, schriftl. Mitt.).

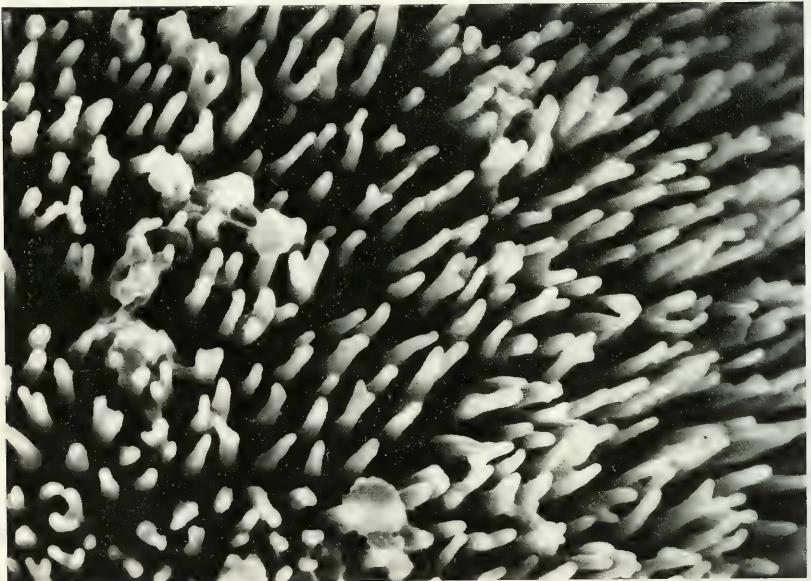


ABB. 7

Aphelidesmus sp. ♀, borstenförmige Mikrotrichien auf dem vorderen Stigma des 3. Körperinges. 4550:1; Foto B. Messner.

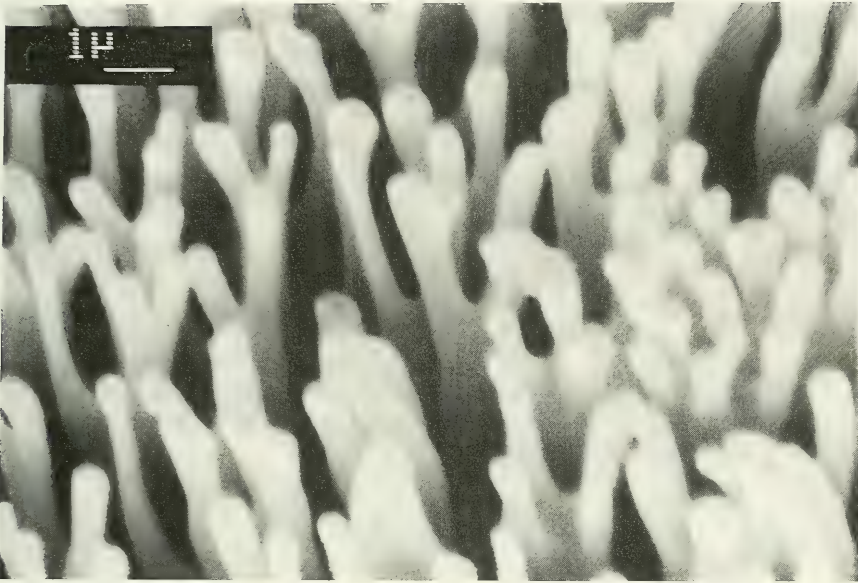


ABB. 8

Mestosoma hylaeicum, ♂, borstenförmige Mikrotrichien auf dem vorderen Stigma des 4. Körperringes. 7530:1; Foto: J. Adis.

Lebendbeobachtungen zu den letztgenannten Arten im submersen Zustand stehen noch aus und sollten baldmöglichst nachgeholt werden.

Warum die nahezu gleich strukturierten Stigmen bei der amazonischen Diplopodenart *Mestosoma hylaeicum*, im Vergleich mit *Selminosoma chapmani*, zu keinem submersen Flucht- oder gar Tauchverhalten geführt hat, ist noch ungeklärt. Es mag aber vielleicht daran liegen, daß die hohe Wassertemperatur ($>28^{\circ}\text{C}$ an der Oberfläche; vgl. SIOLI 1984) und demgemäß der Löslichkeitsdruck des Sauerstoffs zu niedrig liegt bzw. die Tiere selbst zu groß sind und somit ihre Stoffwechselrate zu hoch ist, um einen stabilen submersen Aufenthalt energetisch überhaupt zu ermöglichen.

DANK

Frau Susanne Hamann (Plön) und den Herren E. & H. Fischer (Greifswald) danken wir herzlich für die gute Aufnahmetechnik.

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Les formes épigées du genre *Oritoniscus* (Crustacea, Isopoda, Oniscidea). I. Le complexe *Oritoniscus flavus*

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Studies on epigeal species of the genus *Oritoniscus* (Crustacea, Isopoda, Oniscidea). I. The *Oritoniscus flavus* complex. – The terrestrial isopod *Oritoniscus flavus* (Budde-Lund, 1906) prove to be a complex of three closely related species: *Oritoniscus violaceus* sp. n., *Oritoniscus intermedius* Vandel, 1957 and *Oritoniscus flavus* (Budde-Lund, 1906) which are described or redescribed using all together morphological features, genetics and molecular markers. These different approaches give convergent results confirming on the validity of the three taxa at a specific level.

Key-words: Isopoda – Oniscidea – *Oritoniscus* – Morphology – Esterase – RAPD-PCR.

INTRODUCTION

Dans le cadre d'une étude portant sur la distribution et l'origine des zones de haut endémisme en Europe de l'Ouest, nous avons été amenés à retenir comme l'un des modèles d'étude, les espèces épigées de l'isopode terrestre du genre *Oritoniscus*. Quatre espèces sur les 22 actuellement décrites remplissaient cette condition à savoir: *O. bonadonai* Vandel, 1948, *O. flavus* (Budde-Lund, 1906), *O. pyrenaeus* (Racovitza, 1907) et *O. remyi* Dalens, 1964. Un premier examen nous a montré qu'au sein de ces 4 espèces s'individualisaient 2 groupes caractérisés, l'un par une différenciation très poussée des caractères sexuels secondaires mâles au niveau des péréiopodes II et III que nous baptisons complexe *O. flavus* et qui fait l'objet de la présente note; l'autre sans différenciation aucune de ces mêmes péréiopodes que nous nommons complexe *O. pyrenaeus* et qui fera l'objet d'une prochaine publication.

Initialement composé de la seule espèce *O. flavus* avec les 2 sous-espèces: *O. flavus flavus* et *O. flavus simplex* le complexe *O. flavus* nous est rapidement apparu comme beaucoup plus étoffé, les 2 sous-espèces constituant en fait des espèces à part

entière dont l'une *O. simplex* n'appartient même pas au complexe étudié tandis que 2 espèces nouvelles se révélaient appartenir à cet ensemble.

La présente note est donc consacrée à la description ou à la redescription des 3 espèces du complexe *O. flavus* à la faveur de caractères morphologiques discriminants nouveaux. S'y ajoutent deux autres approches, l'une relative à l'analyse des profils estérasiqes des différents taxons, l'autre concernant l'étude de leur ADN génomique au moyen de la méthode dite de RAPD-PCR, ceci dans l'optique de vérifier si les 3 approches aboutissaient à des résultats congruents.

MATÉRIEL ET MÉTHODES

Morphologie – Le matériel étudié provient essentiellement de nombreuses récoltes effectuées par les deux premiers auteurs dans différentes régions de la chaîne pyrénéenne. Ont également été examinées des collections du BMNH et de la Monks Wood Experimental Station d'Huntingdom en Grande-Bretagne, ainsi que les échantillons de la collection A. Vandel léguée au MNHN et provisoirement déposée au Laboratoire de Zoologie-Ecologie de l'Université Paul Sabatier à Toulouse.

Polymorphisme enzymatique – L'analyse est effectuée sur des individus mâles provenant de la même station (source Hamée, Cne d'Estadens, Hte Garonne). Afin d'éliminer les variations d'ordre physiologique pouvant survenir au cours du cycle de mue (DALENS & ROUSSET, 1988), nous avons utilisé des individus mâles adultes suivis individuellement en élevage et fixés le troisième jour après l'ecdysis. Ils sont mis en microtube contenant 50 µl de tampon de Trudgill (Tris-HCl 0.1 M pH 8, acide ascorbique 0.018%, cystéine hydrochlorure 0.014%, triton X-100 0.01%). Les tubes sont conservés à -20°C. Lors de leur utilisation les individus sont broyés *in situ* puis centrifugés pendant 20 minutes à 15000g et à 4°C. Le surnageant (extrait brut) peut être soit immédiatement chargé dans les puits du gel d'acrylamide soit conservé à -20°C. La migration électrophorétique est individuelle, elle porte sur environ 1/4 de l'extrait brut et est comparée à un mélange de 1/16 de chacun des 4 individus. L'électrophorèse est conduite à 4°C, en gel de polyacrylamide à 7% en gradient de pH (gel de tassement pH 6.8 et gel de séparation pH 8.8) en plaque 160 x 200 x 1 mm. La migration se fait à voltage constant, d'abord 100 V pendant 30 minutes puis 300 V pendant environ 3 h. La révélation est assurée par le colorant Fast Blue RR en utilisant le β-naphthyl acetate comme substrat. La caractérisation des fractions présentant une activité enzymatique est basée sur leur mobilité électrophorétique relative (Rf), l'indice 100 correspondant au front coloré par le bleu de bromophénol.

Polymorphisme de l'ADN – L'analyse porte également sur des individus mâles des trois taxa *O. violaceus*, *O. flavus* et *O. intermedius* prélevés dans la même station (source Hamée, Cne d'Estadens Hte Garonne). Les spécimens sont stockés à -20°C ou en éthanol 95°. Chaque individu est broyé dans 100 µl d'une solution aqueuse à 10% de résine chélatrice Chelex 100 (Walsh, 1991). Le broyat est incubé 30 min à 55°C puis 15 min à 100°C et centrifugé 2 min à 15000 g. Le surnageant peut être utilisé immédiatement ou conservé à -20°C.

– Conditions d'amplification. La méthode employée est celle dite : RAPD- PCR (random amplified polymorphic DNA – polymerase chain reaction). Un μl d'extrait brut d'ADN est amplifié dans 25 μl de tampon (75 mM tris-HCl pH 9.0 20 mM $(\text{NH}_4)_2\text{SO}_4$ 0,01% Tween 20 1,25 mM MgCl_2) contenant 100mM de chaque dNTP, 40 ng d'amorce (oligonucléotide) et 0,5 unité de Taq DNA polymerase (Eurogentec). Les échantillons sont recouverts de 3 gouttes d'huile minérale et sont soumis à 40 cycles d'amplification; chaque cycle comprend: 10 sec à 95°C, 30 sec à 36°C, 1 min à 72°C. Le produit d'amplification est chargé sur un gel d'acrylamide à 7%, séparé par électrophorèse (7 V/cm pendant 4 h.), les fragments d'ADN sont révélés par coloration au bromure d'éthidium (0,5 mg/ml) pendant 15 minutes et photographiés sur un transilluminateur ultra-violet avec un film Polaroid (type 667 ou 665). Chaque gel contient les comigrations correspondantes à 8 individus de chacune des 3 espèces.

– Analyse des données – Les fragments d'ADN séparés sur les gels sont utilisés comme marqueurs pour détecter les variations génétiques à différents niveaux. Ces variations sont décelées parmi les biotypes, à l'intérieur de populations ou entre espèces apparentées (BLACK *et al.*, 1992). Les bandes d'ADN révélées par cette méthode se séparent de manière indépendante, suggérant qu'elles représentent des loci individuels, la majorité des allèles étant dominants (WILLIAMS *et al.*, 1991). Ainsi, le phénotype dominant, lié à un locus RAPD, se traduit sur le gel d'électrophorèse par une bande de poids moléculaire spécifique. Une comparaison est alors possible entre les individus pour chacun des loci: l'absence d'une bande, chez l'un et chez l'autre indique une homozygotie alors que la présence simultanée chez les deux spécimens ne peut discriminer hétérozygotie ou homozygotie dominante (WELSH *et al.*, 1991). La mesure de la similitude entre individus s'effectue en déterminant le pourcentage de présence (ou d'absence) simultanée d'une bande chez les deux individus selon la formule: $M = N_{AB}/N_T$ où N_{AB} est le nombre total de concordances (présence simultanée ou absence simultanée) entre les individus A et B et N_T le nombre total de loci étudiés. La mesure des distances génétiques est effectuée par la méthode UPGMA (unweighted pair-group method of arithmetic averages) sur les valeurs de (1-M) en utilisant le programme informatique Fortran RAPDPLOT élaboré par KAMBHAMPATI *et al.*, 1992. Ce programme calcule les valeurs de M à partir du tableau des données (présence - absence) individuelles relatives aux différents loci et aux différentes amorces d'oligonucléotides et ensuite établit la matrice (1-M) qui, utilisée par les programmes NEIGHBOR et DRAWTREE de l'ensemble PHYLIP 3.5c (distribué par J. Felsenstein, Univ. of Washington, Seattle, WA, USA), permet une évaluation graphique des relations phénétiques entre les taxa étudiés.

RÉSULTATS

ETUDE MORPHOLOGIQUE

Oritoniscus flavus (Budde-Lund, 1906)

Trichoniscus vividus, Budde-Lund 1885: 245 nec C.L. Koch 1841

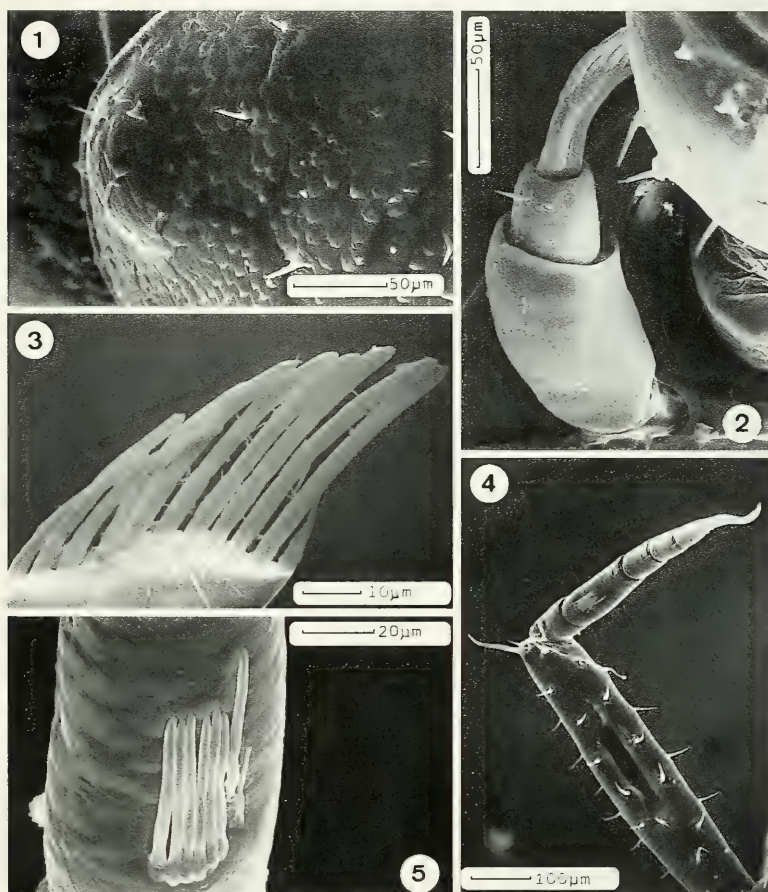
Trichoniscus flavus Budde-Lund, 1906: 83

Trichoniscus (Oritoniscus) flavus, Racovitza 1908: 332

Oritoniscus flavus, Vandel 1933: 45

Oritoniscus flavus flavus, Vandel 1960: 190, figs 83–85

BUDDE-LUND (1885) signale cette espèce de La Preste dans le midi de la France, espèce qu'il rattache par erreur à *Trichoniscus vividus* Koch. La description originale qu'il en donne est totalement muette sur les caractères sexuels mâles et



FIGS 1–5

Oritoniscus flavus. 1: ocelle gauche; 2: A1 *in toto*; 3: aesthetascs apicaux de A1; 4: 5e article de la hampe et flagelle antennaire de A2; 5: aesthetascs du second pseudoarticle flagellaire.

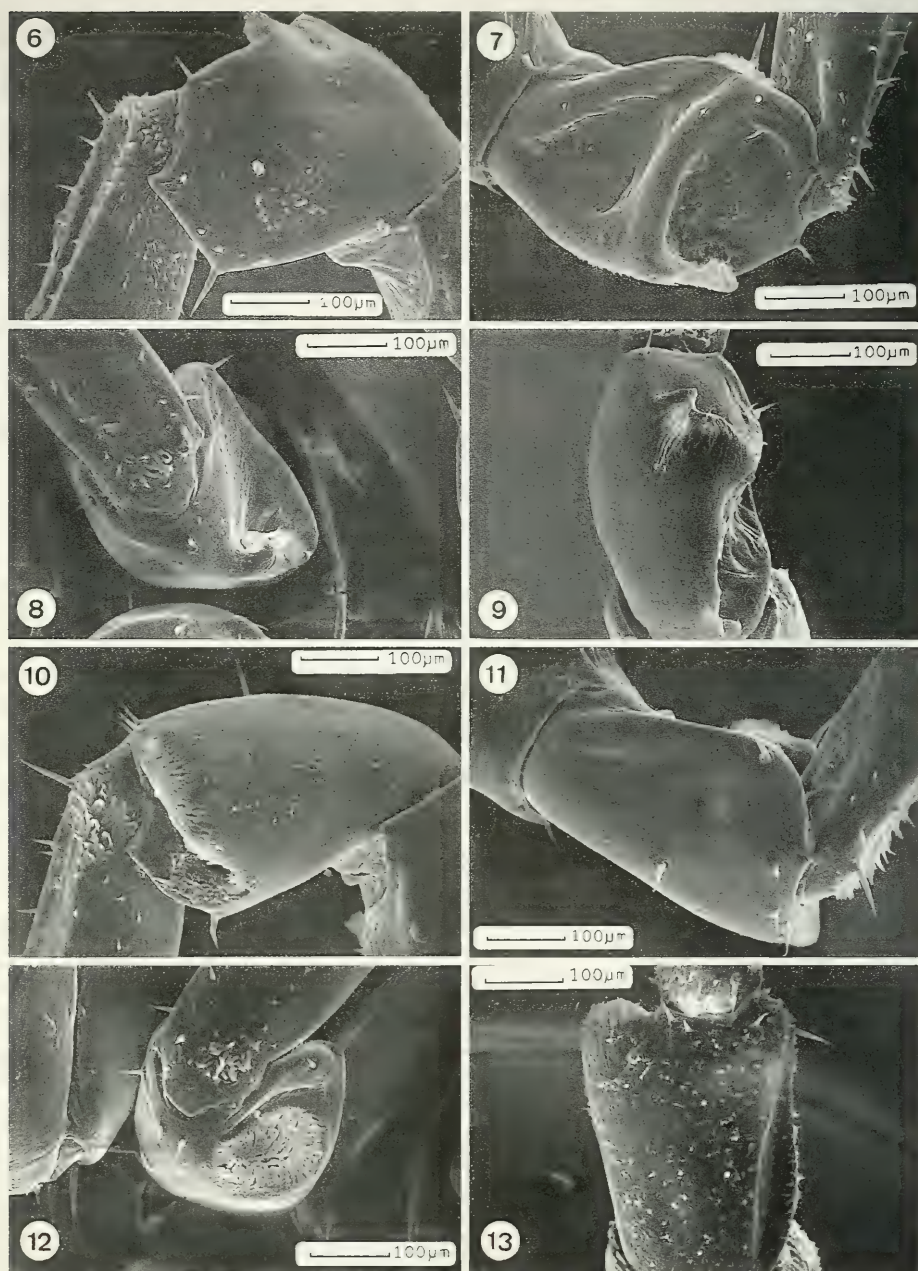
permet donc d'y reconnaître pratiquement n'importe laquelle des espèces épigées du genre *Oritoniscus*. Ce n'est qu'en 1906 que le même auteur reconnaît qu'il s'agit d'une espèce pyrénéenne nouvelle à laquelle il donne le nom de *Trichoniscus flavus* sans pour autant compléter sa description.

Notre première interrogation a donc été de savoir auquel des 3 taxa que nous avions reconnus, s'appliquait la description de Budde-Lund; d'où la nécessité de retrouver soit l'holotype s'il existait, à défaut un lectotype, ou des syntypes. Le Zoologisk Museum de Copenhague ne possédait aucun des échantillons examinés par Budde-Lund, il en allait de même pour le MNHN de Paris. En ce qui concerne les syntypes figurant dans la collection du BMNH de Londres, ils ne sont composés que de femelles et donc inutilisables pour la recherche qui nous intéressait puisque basée sur des caractères sexuels secondaires mâles. Nous nous sommes donc résolus à nous rendre dans la localité-type de La Preste dans les Pyrénées-Orientales afin d'y rechercher la forme existante pour désigner parmi les échantillons collectés, un topotype sur lequel serait basée une description moderne de l'espèce.

Matériel examiné: syntypes de la collection Budde-Lund, déposés au BMNH de Londres, reg. n° 1921:10:18:574–579 La Preste, France; 5 ♀ plus ou moins intactes et débris de 2 autres ♀ ♀; La Preste (Pyr. Or.) 2°25'3"E–45°24'40"N, alt. 1040 m, 25.V.1994 Dalens & Rousset réc. dans un amas de feuilles mortes au pied de rochers: 1 ♂ qui constitue le topotype (MNHN) et 13 ♂ ♂ récoltés intimement mélangés avec l'espèce *O. remyi*; La Barragane, Cne de la Preste, alt. 1230 m, 25.V.1994 Dalens & Rousset réc.: 9 ♂ ♂ également mélangés à l'espèce *O. remyi*; Source Hamée, Cne d'Estadens (Hte-Garonne), alt. 555 m, V–VI.1994 Rousset réc.: 35 ♂ ♂ en mélange avec *O. intermedius*, plus exceptionnellement avec *O. violaceus* sp. n.; Salau (Ariège), alt. 1100–1250 m, 2.VI.1994 Dalens & Rousset réc.: 115 ♂ ♂ récoltés en trois stations au bas des cirques d'Anglade et du Léziou en mélange avec *O. intermedius* et *O. remyi*; Pont d'Anglade, Cne de Seintein (Ariège), alt. 800 m, 23.XI.1994 Dalens & Rousset réc.: 99 ♂ ♂ et 12 ♀ ♀; Fontaine de la Bièle, Cne de Luzenac (Ariège), alt. 710 m, 23.XI.1994 Dalens & Rousset réc.: 105 ♂ ♂ et 101 ♀ ♀; La Môle, Cne d'Erp (Ariège), alt. 530 m, 8.XII.1994 Dalens & Rousset réc.: 16 ♂ ♂ et 30 ♀ ♀; aven K2, Cne de St-Amancet (Tarn), 4.VI.1977 Deharveng réc.: 2 ♂ ♂ et 4 ♀ ♀.

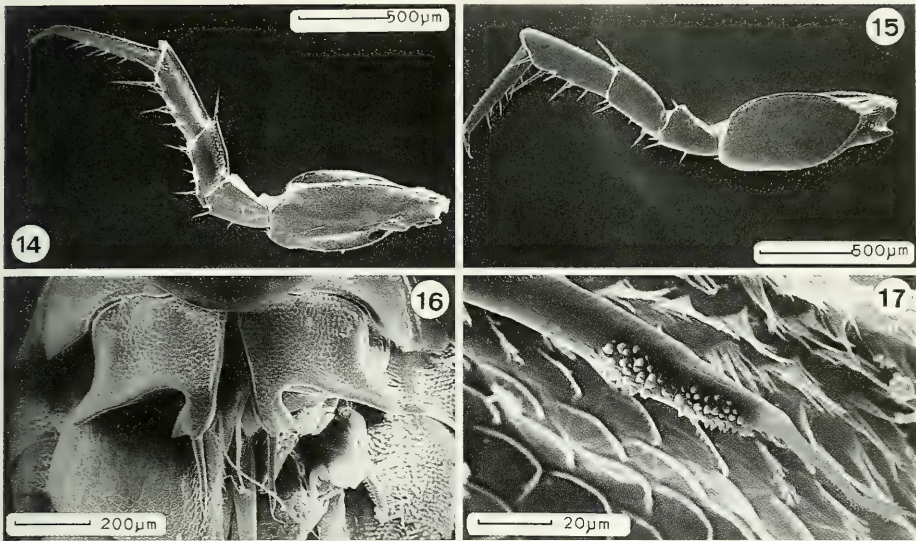
Nous avons également réexaminé les échantillons présents dans la collection Vandel sous la dénomination: *Oritoniscus flavus* ou *Oritoniscus flavus flavus*. Bien que n'ayant jamais eu les types en examen, cet auteur est en effet celui qui a donné la description la plus précise et la plus complète concernant cette espèce. La majorité de ses déterminations correspond effectivement à des *O. flavus* tels qu'ils seront redéfinis à partir du topotype. Cependant s'y retrouvent parfois mélangés des *O. intermedius*, mais aussi, bien que plus exceptionnellement, des individus que nous avons reconnu appartenir à une nouvelle espèce: *O. violaceus* sp. n.

Description: taille de 4 à 5 mm pour le mâle, jusqu'à 7 mm chez la femelle. La coloration est marron pourpre, devenant rouge brique lorsque l'animal vivant est examiné dans l'eau. En alcool, les animaux perdent plus ou moins rapidement leur coloration et prennent généralement une couleur jaunâtre d'où le terme de *flavus*. On peut également trouver des individus soit jaune orangé translucide, soit de couleur jaunâtre pâle et mate et parfois légèrement opalescents. Chez ces derniers, les anomalies de la pigmentogenèse paraissent assez fréquemment corrélés à des infestations vraisemblablement par iridiovirus. En alcool certains de ces individus



FIGS 6-13

Ortoniscus flavus. 6: ischion P II, face antérieure; 7: face postérieure; 8: vue apicale; 9: vue sternale; 10: ischion P III, face antérieure; 11: face postérieure; 12: vue apicale; 13: vue sternale.



Figs 14–17

Oritoniscus flavus. 14: péréiopode V en vue postérieure; 15: en vue antérieure; 16: pléopodes 1 mâle *in toto*; 17: extrémité de la tige de l'exopodite 1 mâle.

deviennent rapidement et totalement décolorés et paraissent alors correspondre à des formes albinos. L'oeil est constitué d'un ocelle unique de grande taille et pigmenté de noir. Toutefois, et ceci se retrouve chez les 3 espèces dont il est question dans cette note, lorsque l'ocelle est examiné au microscope électronique à balayage, il ne peut être repéré que grâce au bombement de la carapace à son niveau; la structure cuticulaire est par contre rigoureusement identique à celle du reste du vertex (Fig. 1), ce qui traduit un début de régression de l'appareil oculaire, lequel a totalement disparu chez la majorité des représentants non épigés du genre *Oritoniscus*. Les téguments sont lisses et garnis de soies simples. L'antennule (Figs 2–3) est formée de 3 articles dont le second porte une forte épine en position latéro-interne, et le distal est surmonté de 10 aesthéscas et d'une épine externe assez courte. L'article 5 de la hampe de l'antenne (Fig. 4) porte sur sa face antérieure une fossette longitudinale; quant au flagelle il est formé de 5 (parfois 6) pseudo-articles dont le second porte à son tiers inférieur 5 à 7 aesthéscas (Fig. 5). Uropode à endopodite s'insérant plus bas que l'exopodite et plus fin que ce dernier, mais de longueur sensiblement égale. Les péréiopodes II, III et V présentent chez le mâle des différenciations sexuelles particulièrement nettes et caractéristiques du taxon. Au niveau du péréiopode II, l'ischion (Figs 6–9) est ramassé et porte sur sa face postérieure une profonde dépression d'où émerge au niveau du bord sternal une touffe d'écailles piliformes. Sur le péréiopode III, l'ischion (Figs 11–13) est également raccourci et porte sur la partie distale de sa face antérieure un replat supportant une plage d'écailles piliformes. Quant au péréiopode V (Figs 14–15), il présente un basis fortement renflé du fait de l'élargissement de sa face antérieure. Le basis du péréiopode VII du mâle présente

également une très légère différenciation sexuelle qui se traduit par la présence d'une petite touffe de soies en écailles à l'angle sterno-distal. Le premier pléopode mâle montre un exopodite subrectangulaire portant un lobe externe d'autant plus nettement individualisé que l'individu est de plus grande taille et un lobe interne armé distalement d'une forte tige, verruqueuse à son extrémité, avant de se terminer par un court flagelle cilié (Figs 16–17).

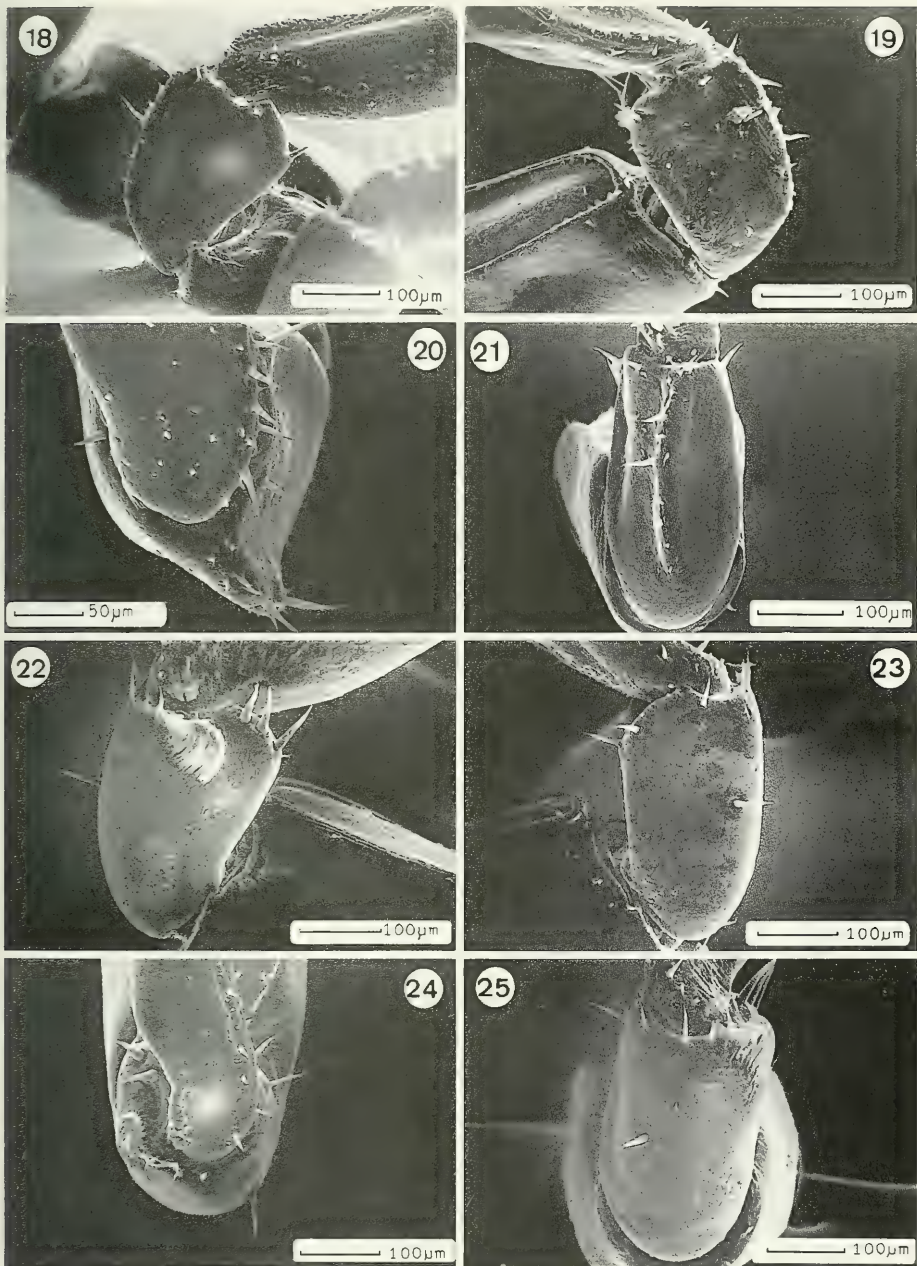
Répartition: Nos propres récoltes, ainsi que l'examen des échantillons représentés dans la collection Vandel, nous permettent d'affirmer que l'espèce est présente de façon certaine, dans toute la moitié orientale des Pyrénées françaises, depuis la vallée de l'Ouzom à l'ouest, jusque dans le Haut Vallespir à l'est. En Espagne nous l'avons retrouvée dans le Val d'Aran. D'après VANDEL (1960), il semble (bien que nous n'ayons pu toujours le vérifier par nous-mêmes) que ce soit ce taxon qui ait colonisé le Bassin Aquitain, les Charentes et le Poitou, ainsi qu'une partie du Massif Central. Les échantillons que nous avons pu examiner, provenant de différents comtés d'Irlande ainsi que de la région de Carmothen dans le Pays-de-Galles en Grande Bretagne même, nous permettent de confirmer qu'il s'agit bien également de l'espèce *flavus*. Ce taxon constituerait donc bien une espèce à vaste répartition et qui serait même à l'heure actuelle en voie d'expansion, notamment dans la région septentrionale de son aire de répartition.

Oritoniscus intermedius Vandel, 1957

Oritoniscus flavus intermedius Vandel, 1957: 92, fig. 1B

Il convient ici de rappeler, que dans un travail de 1957, VANDEL avait considéré que l'espèce *O. flavus* se scindait en 3 sous-espèces dont il décrivait – très succinctement il est vrai – 2 nouvelles sous-espèces: *O. flavus simplex* n. ssp. et *O. flavus intermedius* n. ssp. Cependant dans la Faune de France des Isopodes terrestres parue en 1960, il ne reconnaissait plus à *O. flavus* que 2 sous-espèces: *O. flavus flavus* et *O. flavus simplex*; considérant que la sous-espèce précédemment décrite sous le nom d'*intermedius*, ne constituait en fait qu'une forme juvénile de la sous-espèce *O. flavus flavus*. Or les échantillons que VANDEL avait désignés sous le nom d'*intermedius* correspondent manifestement à un taxon bien défini.

Matériel examiné: un certain nombre d'échantillons de cette espèce figurent dans la collection A. Vandel, seuls ou plus généralement en mélange avec *O. flavus*. Sous la dénomination *O. flavus*: Niaux (Ariège), 2.VI.1933, 1 ♂ et 2 ♀♀; sous la dénomination *O. flavus flavus*: Luchon (Hte-Garonne), 26.VIII.1954, 3 ♂♂ et 6 ♀♀; sous la dénomination *O. flavus intermedius*: Puymorens (Ariège), 2.XI.1955, 12 ♂♂ et 18 ♀♀; Cirque de Leziou, Mt Rouch/Salau (Ariège), 30.VIII.1954, 6 ♂♂ et 6 ♀♀. Le descripteur n'ayant pas désigné d'holotype, mais les stations d'Anglade et du Leziou sur la commune de Salau (Ariège) ayant servi de localités types, nous avons sélectionné un échantillon mâle parmi ceux de cette station figurant dans la collection Vandel pour servir de lectotype. La crête sternale de l'ischion II caractéristique de l'espèce étant peu visible sur préparation microscopique et la diagnose spécifique étant beaucoup plus facile et évidente sur l'animal *in toto*, nous avons jugé préférable de conserver le lectotype intact et de baser l'illustration de notre description sur d'autres échantillons provenant de la même localité. Güells del Joeu, Val d'Aran en Espagne, alt. 1400 m, 20.VIII.1994 Rousset réc.: 4 ♂♂ et 8 ♀♀; Cirques d'Anglade et du Leziou, Cne de Salau (Ariège), alt. 1100–1250 m, 2.VI.1994 Dalens & Rousset réc.: 24 ♂♂ en mélange avec *O.*



FIGS 18–25

Oritoniscus intermedius. 18: Ischion P II, face antérieure; 19: face postérieure; 20: vue apicale; 21: vue sternale; 22: Ischion P III, face antérieure; 23: face postérieure; 24: vue apicale; 25: vue sternale.

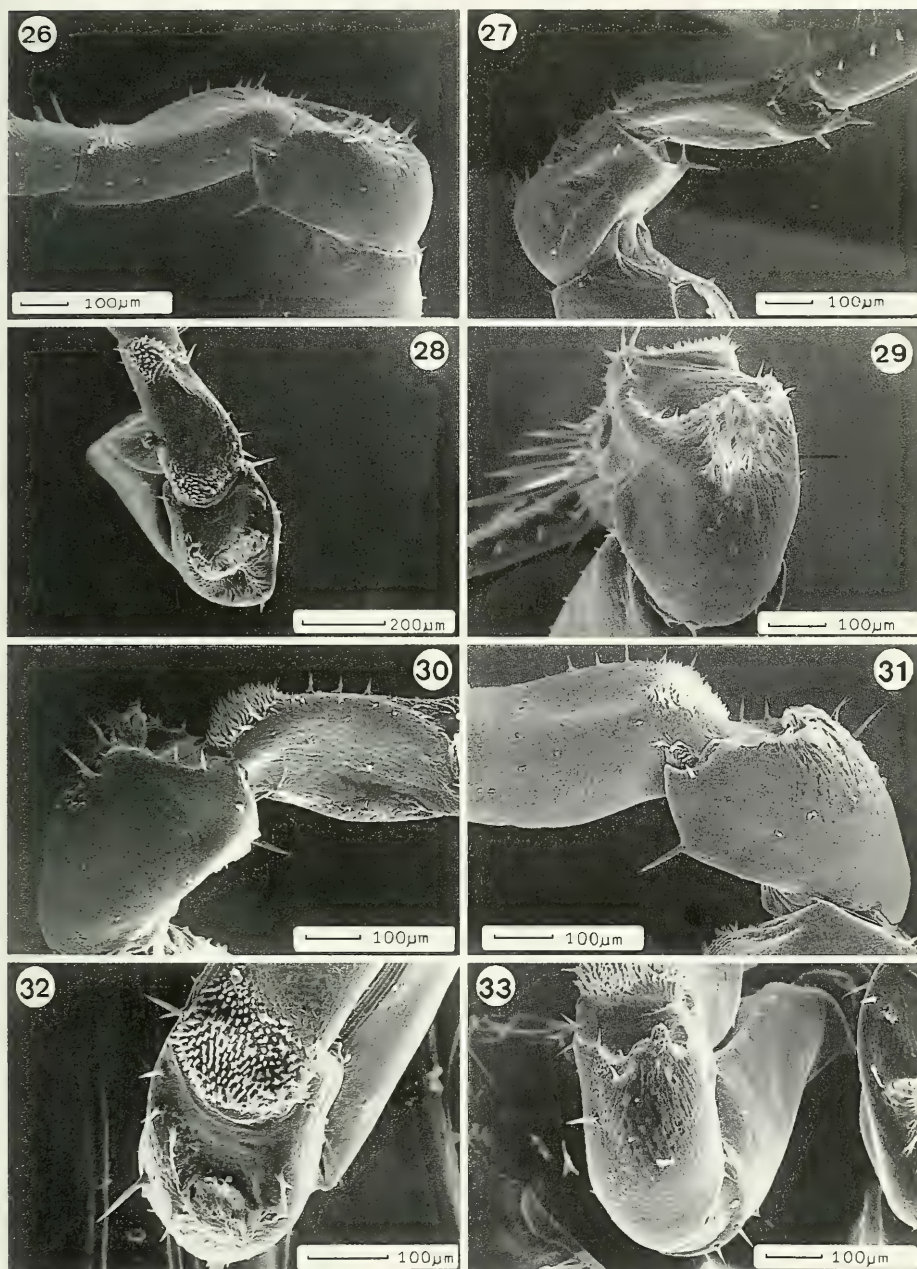
flavus; Le Freyche, Cne de Nescus (Ariège), alt. 450 m, 28.VI.1994 Dalens & Rousset réc.: 4 ♂♂ mélangés à l'espèce *O. remyi*; Arbosec, Cne de Riverenert (Ariège), alt. 645 m, 8.XII.1994 Dalens & Rousset réc.: 15 ♂♂ et 41 ♀♀; résurgence, Cne de Taurignan-le-Vieux (Ariège), alt. 386 m, 8.XII.1994 Dalens & Rousset réc.: 2 ♂♂ en mélange avec *O. remyi*; Ruau, Cne Izaut de l'Hôtel (Hte-Garonne), alt. 800 m, VIII.1994 Rousset réc.: 7 ♂♂ en mélange avec *O. violaceus*; Baillugues, Cne d'Estadens (Hte-Garonne), alt. 480 m, 26.IV.1994 Rousset réc.: 17 ♂♂ et 41 ♀♀, 2.V.1994 Rousset réc.: 30 ♂♂ et 78 ♀♀, 16.VI.1994 Dalens & Rousset réc.: 36 ♂♂ et 45 ♀♀; source Hamée, Cne d'Estadens (Hte-Garonne), alt. 555 m, 16.VI.1994 Dalens & Rousset réc.: 35 ♂♂ en mélange avec l'espèce *O. flavus*; Cap de l'Ane, Cne de Sost (Htes-Pyrénées), alt. 757 m, 18.X.1994 Dalens & Rousset réc.: 1 ♂ et 4 ♀♀; Sources captées, Cne de Sost (Htes-Pyrénées), alt. 920 m, 18.X.1994 Dalens & Rousset réc.: 14 ♂♂ en mélange avec *O. flavus* et une nouvelle espèce d'*Oritoniscus*; Maison Bourdette, Cne de Nistos (Htes-Pyrénées), alt. 630 m, 18.X.1994 Dalens & Rousset réc.: 52 ♂♂ et 51 ♀♀.

Description: taille un peu plus réduite que chez l'espèce précédente: 4 mm maximum pour les mâles, 6 mm pour les femelles. Coloration un peu plus rouge que chez *O. flavus* lorsque l'animal est examiné vivant dans une coupelle remplie d'eau. Individus jaune-orangé translucide relativement fréquents mais toujours en petit nombre dans une même population. Antennule avec 5 à 7 aesthétascs apicaux flanqués d'une courte épine. Flagelle antennaire formé de 4 à 5 pseudo-articles. Les caractères les plus évidents et discriminant l'espèce, affectent les péréiopodes mâles II et III. Au niveau du péréiopode II, le carpos présente sur sa face sternale une brosse de courtes soies denses qui manquent chez la femelle. C'est néanmoins l'ischion (Figs 18–21) qui est caractéristique par son élargissement dû au développement d'une crête sternale, portant de courtes soies sur sa partie distale. Sur le péréiopode III, le carpos porte également une brosse de soies sternales; quant à l'ischion (Figs 22–25) s'il présente sensiblement la même architecture que chez *O. flavus*, la plage de soies est ici réduite à une petite touffe, proche de l'arête sternale et est flanquée en avant et en arrière de 3 fortes épines. L'élargissement du basis V que l'on note chez *O. flavus* est absent chez *O. intermedius*. Par contre tout comme chez *O. flavus*, le basis du péréiopode VII présente une très petite touffe de soies à l'angle sterno-distal. Les pléopodes mâles 1 et 2 sont semblables à ceux d'*O. flavus* mais on ne retrouve pas le développement hyperthélique de la pointe externe de l'exopodite 1 chez les plus grands individus.

Répartition: Nos propres récoltes et l'examen des échantillons de la collection Vandel, nous autorisent à dire qu'*O. intermedius* se trouve dans toute la partie orientale de la chaîne pyrénéenne, la limite ouest paraissant être, au moins à ce jour, la vallée de la Neste d'Aure (Htes-Pyrénées).

***Oritoniscus violaceus* sp. n.**

Matériel examiné: Holotype (déposé au MNHN): 1 ♂ provenant de la source Hamée, Cne d'Estadens (Hte-Garonne), alt.: 555 m, 0°51'36"E–43°1'43"N, 7.V.1994 Rousset réc., Paratypes: 16 ♂♂ et 29 ♀♀ provenant de la même station, dans la mousse ou sous les pierres recouvertes d'un filet d'eau courante d'un petit griffon à flanc de coteau et sur une distance d'une dizaine de mètres en aval de ce dernier, dans le lit du ruisseau naissant, en compagnie de gammarès et de larves d'Osmyles; source Ruau, Cne d'Arbon (Hte-Garonne), alt. 784 m, 25.IV.1993 Lek réc.: 12 ♂♂ 23 ♀♀ 8 immatures; sources de la Maure, Cne Izaut de l'Hôtel (Hte-Garonne), alt. 430 m, 22.V.1993 Lek réc.: 46 ♂♂ 68 ♀♀; idem, 12.XI.1994 Rousset réc.:



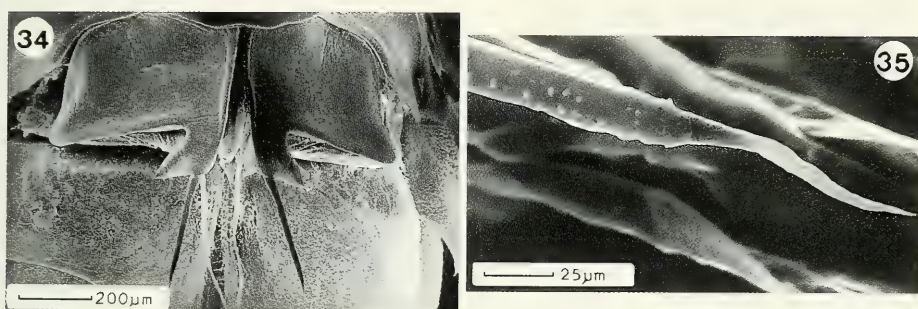
FIGS 26–33

Oritoniscus violaceus. 26: ischion et meros P II, face antérieure; 27: face postérieure; 28: ischion en vue apicale, meros en vue sternale; 29: ischion en vue sternale; 30: ischion P III, face antérieure; 31: face postérieure; 32: vue apicale; 33: vue sternale.

61 ♂♂ 83 ♀♀ 53 immatures; déversoir de l'abreuvoir de Sauère, Cne de Chein Dessus (Hte-Garonne), alt. 850 m, 3.V.1994 Rousset réc.: 14 ♂♂ en mélange avec quelques *O. intermedius*; source de Surgeint, Cne de Herran (Hte-Garonne), alt. 800 m, 30.VII.1994 Rousset réc.: 17 ♂♂ en mélange avec 1 ♂ *O. flavus*; source à Milhas (Hte-Garonne), alt. 674 m, 2.VIII.1994 Rousset réc.: 48 ♂♂ 66 ♀♀; petite cascade dans le vallon de la Chapelle St-Martin, Cne de Marignac (Hte-Garonne), alt. 720 m, 8.XI.1994 Dalens & Rousset réc.: 53 ♂♂ 71 ♀♀ 19 immatures; source du Rigodet dans la descente est du Col de Menté, Cne de Boutx (Hte-Garonne), alt. 1295 m, 8.XI.1994 Dalens & Rousset réc.: 2 ♂♂ en mélange avec 1 ♂ *O. flavus* et présence de gammares; fontaine des Baous, Cne de Couledoux (Hte-Garonne), alt. 680 m, 8.XI.1994 Dalens & Rousset réc.: 18 ♂♂ 23 ♀♀ 37 immatures; fontaine de Lalière à la Henne Morte, Cne de Juzet d'Izaut (Hte-Garonne), alt. 620 m, 12.XI.1994 Rousset réc.: 11 ♂♂ 23 ♀♀ 12 immatures; écoulement de Jouan d'Arau, Cne de Luzenac (Ariège), alt. 550 m, 23.XI.1994 Dalens & Rousset réc.: 7 ♂♂ en mélange avec *O. flavus* en présence de gammares et de larves d'osmyles; source lavoir-abreuvoir d'Uchentein (Ariège) alt. 930 m, 23.XI.1994 Dalens & Rousset réc.: 16 ♂♂ en mélange avec *O. flavus* en présence de gammares; source de Roquelaure, Cne de Taurignan le Vieux (Ariège) alt. 370 m, 8.XII.1994 Dalens & Rousset réc.: 6 ♂♂ en mélange avec *O. flavus*. Dans la collection Vandel, sous la dénomination *O. flavus* figurent 2 ♂♂ et 3 ♀♀ d'*O. violaceus* provenant de l'entrée de la grotte de Lestélas, Cne de Cazavet (Ariège) (réf. Biosp. 554A) ainsi que 4 ♂♂ et 4 ♀♀ provenant d'Arbas (Hte-Garonne) IX.1954.

Description: le mâle peut atteindre la taille de 5,8 mm et la femelle celle de 7 à 7,5 mm. La coloration est nettement plus sombre que chez les deux espèces précédentes et examiné vivant dans une coupelle remplie d'eau l'animal prend le plus souvent une teinte bleu-violette d'où le nom spécifique que nous lui attribuons. L'antennule porte des aesthéscas apicaux dont le nombre semble varier de 5 à 8 (plus l'épine latéro-externe). Une dissymétrie A1 droite A1 gauche du nombre d'aesthéscas semble relativement fréquente. Le flagelle antennaire est formé en règle générale de 5 pseudo-articles, toutefois on peut observer des flagelles à 4 ou à 6 pseudo-articles, le nombre d'aesthéscas du second pseudo-article pouvant varier de 4 à 10 avec fréquemment dissymétrie d'un flagelle à l'autre chez un même individu. Ce sont ici également les péréiopodes II et III du mâle qui portent les caractères vraiment discriminants de l'espèce. Au niveau du péréiopode II (Figs 26–29), la face sternale de l'ischion présente dans sa région distale une profonde dépression tapissée de soies qui forment une touffe centro-médiane. Le méros porte une brosse de soies aux deux extrémités (basale et distale) de la face sternale. Une brosse identique se retrouve sur la plus grande partie de la face sternale du carpos. Sur le péréiopode III (Figs 30–33), l'ischion porte également une dépression assez semblable à celle de l'ischion II, mais s'étendant un peu moins sur la face sternale, la houppe de soies étant située plus près de l'extrémité distale de l'article. Une grosse brosse de soies orne la base sternale et la région sterno-distale du méros ainsi que la majeure partie de la face sternale du carpos. L'élargissement du basis V est également absent chez cette espèce, mais tout comme chez *O. flavus* et *O. intermedius* l'angle sterno-distal du basis VII porte une toute petite touffe de soies. Les pléopodes 1 (Fig. 34) et 2 du mâle sont semblables à ceux d'*O. intermedius*, on relève tout au plus que les verrucosités de l'extrémité de la tige de l'exopodite 1 sont moins développées que chez les espèces précédentes (Fig. 35).

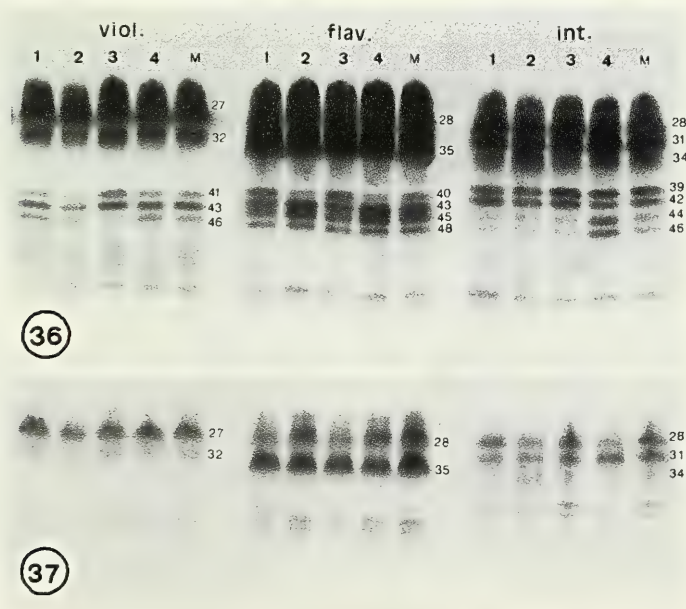
Répartition: La répartition d'*O. violaceus* paraît s'inscrire dans un quadrilatère (20 x 35 km) défini à l'ouest et au nord par la vallée de la Garonne, à l'est par la vallée du Salat et au sud par celles du Lez et du Maudan. Il ne semble pas toutefois que ces



FIGS 34–35

Ortoniscus violaceus. 34: pléopodes 1 mâle *in toto*; 35: extrémité de la tige de l'exopodite 1 mâle.

vallées aient pu constituer par elles-mêmes des barrières géographiques, car deux stations, celle du vallon de la Chapelle St-Martin à l'ouest et celle de Taurignan le Vieux à l'est débordent légèrement des limites précédemment indiquées. Cependant des prospections effectuées en dehors de ces zones dans des biotopes apparemment favorables, se sont révélées jusqu'à présent négatives.



FIGS 36–37

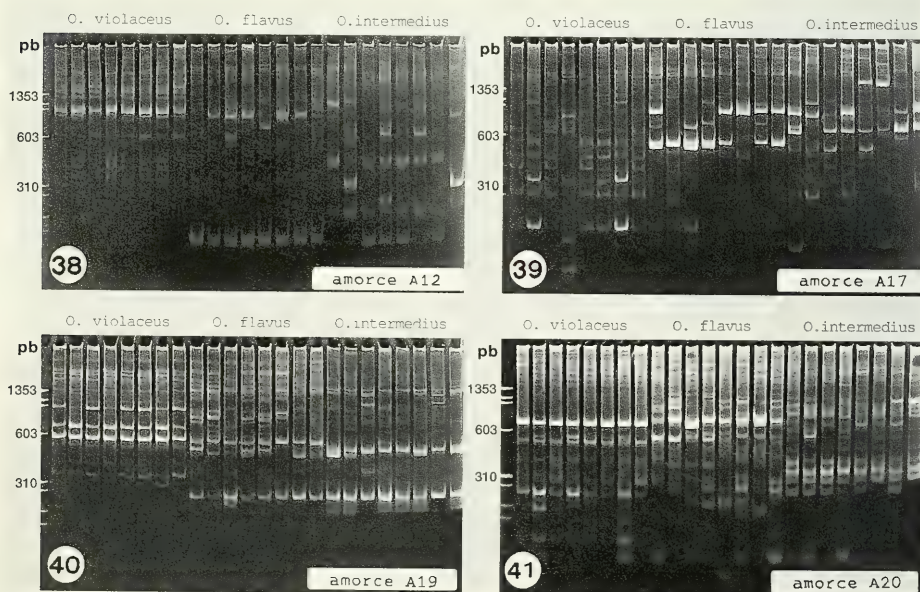
Zymogrammes estérasiques: en (36) pour chaque espèce *O. violaceus*, *O. flavus* et *O. intermedius* l'analyse porte sur les individus 1 à 4 (1/4 du broyat dans chaque puits) et mélange de 1/16 de chaque individu dans le 5^o puits. En (37) mise en évidence des fractions lentes, même disposition mais la quantité déposée dans chaque puits est quatre fois plus faible.

ETUDES GÉNÉTIQUE ET MOLÉCULAIRE

Polymorphisme enzymatique

Les zymogrammes (Figs 36–37) montrent essentiellement deux zones d'activité très différentes. Une première zone concerne des fractions rapides dont l'indice de mobilité est égal ou supérieur à 39. Ces fractions montrent une activité estérasique modérée et leur mise en évidence nécessite environ 1/4 de l'extrait de chaque individu. *O. violaceus* présente trois bandes entre Rf 41 et 46, 4 bandes (Rf 40, 43, 45 et 48) sont visibles chez *O. flavus* et également 4 chez *O. intermedius* mais à des Rf différentes (Rf 39, 42, 44 et 46). Une bande à migration plus rapide (Rf 59) se retrouve de manière constante chez tous les individus des trois espèces. La seconde zone concerne des fractions de migration lente dont l'indice de mobilité s'étend de 20 à 35. Ce sont des fractions de forte activité qui ne requièrent que très peu d'extrait (1/16 d'individu). Deux bandes existent chez *O. violaceus*, (Rf 27 et 32) et chez *O. flavus* (Rf 28 et 35); *O. intermedius* présente trois bandes (Rf 28, 31 et 34).

Ainsi, mis à part la bande la plus rapide (Rf 59) qui est commune aux trois espèces, chacune d'elles montre un pattern qui lui est propre, aussi bien dans les fractions lentes, très intenses que dans les fractions rapides, d'intensité plus modérée.



FIGS 38–41

Gels de polyacrylamide (7%) contenant les fragments d'ADN amplifié par RAPD-PCR, relatifs aux individus 1 à 8 de chacune des 3 espèces *O. violaceus*, *O. flavus* et *O. intermedius*. Chaque gel correspond à l'amplification avec une amorce d'oligonucléotides différente: A12, A17, A19 et A20.

Polymorphisme de l'ADN génomique

L'extraction de l'ADN génomique par cette méthode donne des résultats fiables et rapides; la quantité extraite est stable et suffisante pour plus d'une centaine d'amplifications. Le niveau de reproductibilité est élevé et aucune différence n'a été relevée entre des amplifications géniques répétées d'un même individu avec une même amorce. La spécificité de l'amplification est toujours testée par l'adjonction d'un tube de contrôle (dépourvu d'ADN), vérifiant ainsi la non pollution de l'expérimentation.

Vingt amorces décarniques ont été testées; quatre ont montré des bandes bien réparties et bien amplifiées (A12: 5'TCGGCGATAG3'; A17: 5'GACCGCTTGT3'; A19: 5'CAAACGTCCG3'; A20: 5'GTTGCGATCC3') et ont été retenues pour l'analyse. Figs 38–41 montrent les patterns électrophorétiques obtenus. Une première observation indique, chez *O. violaceus* une homogénéité des réponses individuelles pour les 4 amorces (remarquable dans le cas de A19), alors que chez *O. flavus* et *O. intermedius* la variabilité individuelle semble plus importante. En outre ces deux espèces semblent posséder quelques bandes communes (voir amorces A19 et A12).

Pour évaluer le polymorphisme génétique, 58 bandes d'ADN bien amplifiées par les 4 amorces d'oligonucléotides précitées ont été utilisées (les bandes de taille supérieure à 1500 paires de bases ne sont pas comptabilisées car moins fiables). Le phénotype (1 pour présence d'une bande, 0 pour son absence) de chaque individu à chaque locus est renseigné dans un tableau de données qui est ensuite analysé par les programmes informatiques précédemment mentionnés (RAPDPLOT et ensemble PHYLIP 3.5c).

Le graphique (Fig. 42) des relations phénétiques basé sur le polymorphisme généré par RAPD-PCR et construit selon la méthode UPGMA montre qu'il y a séparation parfaite des individus en trois taxa. Cette disjonction révélée au niveau génotypique permet d'exclure la possibilité d'échange génique entre ces populations spécifiques vivant dans un espace restreint et de manière quasi sympatrique.

DISCUSSION

Le mélange fréquent, en une même station, de deux de ces espèces, parfois même celui beaucoup plus rare des trois espèces, semble pouvoir expliquer que ces différentes formes n'aient pas été jusqu'à ce jour reconnues, ou lorsqu'elles l'ont été, qu'elles n'aient alors été considérées que comme des sous-espèces, voire des formes juvéniles. Nos propres récoltes nous ont permis de faire deux observations qui établissent sans ambiguïté le statut spécifique de ces trois morphotypes mâles:

- la première est que, pour chacune de ces trois formes, il existe des populations souvent importantes dans lesquelles on ne trouve qu'un seul des morphotypes mâles avec des femelles gravides et tous les intermédiaires entre les formes juvéniles et matures. Ceci exclut que l'un ou l'autre de ces morphotypes ne soit qu'une forme intermédiaire ou une étape de différenciation d'un autre morphotype qui correspondrait à la phase pleinement mature, et confère donc à ces trois formes le statut d'entité taxinomique à part entière.

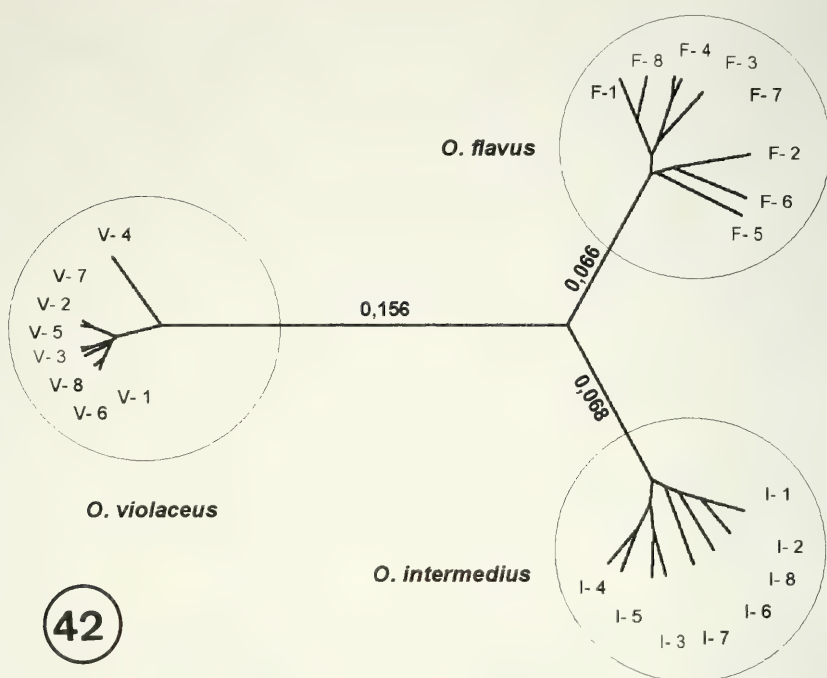


FIG. 42

Diagramme montrant les relations phénétiques entre des individus de populations sympatriques appartenant aux trois espèces *O. violaceus*, *O. flavus* et *O. intermedius* établi d'après un polymorphisme génétique généré par RAPD-PCR et construit en utilisant 58 bandes polymorphiques, les données ont été traitées par la méthode UPGMA – (les individus sont notés V-1 à V-8 pour *O. violaceus*, F-1 à F-8 pour *O. flavus* et I-1 à I-8 pour *O. intermedius*). Les valeurs des distances génétiques sont indiquées sur les branches.

– la seconde est que dans les zones où nous avons récolté en mélange deux ou plus rarement les trois espèces qui coexistent et où se trouvent donc réunies les possibilités au moins théoriques, d'hybridation, nous n'avons jamais trouvé d'individu mâle qui présente un morphotype intermédiaire ou atypique. Ici également, l'approche moléculaire de par la disjonction génotypique qu'elle révèle en liaison étroite avec les différents morphotypes mâles vient appuyer les conclusions tirées des observations morphologiques et biologiques. Nous pouvons donc conclure que ces différentes formes sont génétiquement ou sexuellement isolées, ce qui leur confère le statut d'espèces à part entière.

Sur un plan évolutif, ces trois espèces sont très proches les unes des autres et se rassemblent indiscutablement dans un même groupe caractérisé par une différenciation poussée des périopodes II et III du mâle, par opposition à un autre groupe, lequel fera

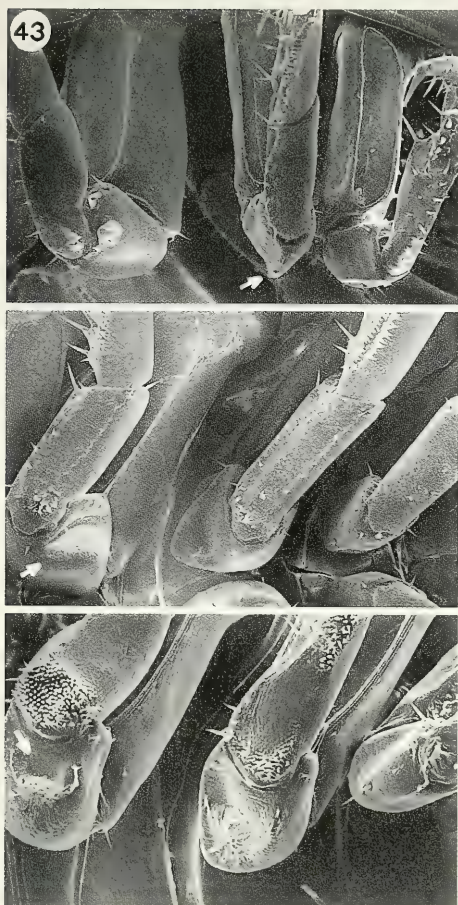
l'objet d'une publication ultérieure et qui réunit les espèces *O. bonadonai*, *O. simplex*, *O. pyrenaeus* et *O. remyi* (ainsi qu'une autre nouvelle espèce) qui se caractérisent par une absence quasi totale de différenciation des péréiopodes mâles.

Sur le plan écologique, ces trois espèces sont des atmophiles stricts, mais il semble exister entre elles des degrés quant à l'amplitude de variation du taux d'hygrométrie qu'elles paraissent susceptibles de tolérer. La plus stricte de ce point de vue semble être l'espèce *O. violaceus* qui est une forme franchement hydrophile, n'ayant jamais été récoltée ailleurs que dans des écoulements d'eau libre permanents et très fréquemment en compagnie de gammares et de larves d'osmyles, ceci dans les mousses de petites cascades plus ou moins encroûtantes, dans les feuilles mortes entassées au pied de ces mêmes cascades ou encore sous des galets partiellement immergés dans les écoulements résultant de petites sources ou résurgences, mais jamais en eau profonde. Il semble même que cette espèce puisse être parfois qualifiée d'amphibie ce qui l'éloigne quelque peu des deux autres espèces qui paraissent un peu mieux adaptées à la vie terrestre. En ce qui concerne l'espèce *O. flavus*, elle n'est pas obligatoirement inféodée à des milieux avec eau libre, bien que sa présence n'y soit pas exceptionnelle; elle reste toutefois cantonnée à des milieux vraiment humides: bords des ruisseaux, amas de feuilles mortes très humides par exemple. Quant à *O. intermedius*, elle paraît être des trois, l'espèce la plus tolérante bien que sa répartition reste limitée à des milieux qui conservent en permanence une certaine humidité. Si on peut la trouver dans des mousses suintantes, sa présence est également très fréquente dans des pierriers ou éboulis profonds plus ou moins recouverts de mousses et sans la moindre trace d'eau libre ou de suintement. Ainsi dans les stations où comme à la source Hamée les trois espèces coexistent sur à peine quelques dizaines de m², *O. violaceus* occupe les biotopes franchement aquatiques, *O. flavus* les bordures du milieu aquatique et les biotopes humides adjacents avec, en règle générale, un film d'eau libre et enfin *O. intermedius* se trouve préférentiellement dans les pierriers et éboulis qui ne comportent ni suintement ni eau libre permanente. Il va sans dire que ces trois milieux et tout particulièrement les deux derniers s'interpénètrent, ce qui explique les éventuels mélanges d'espèces lors de certaines récoltes ceci pour peu que les différentes espèces soient représentées dans le milieu prospecté.

Ces différentes espèces peuvent être introduites dans la clef dichotomique des espèces du genre *Oritoniscus* donnée par VANDEL (1960: 184) selon Fig. 43.

REMERCIEMENTS

Les auteurs tiennent à remercier le Dr N.L. Bruce du Zoologisk Museum, Copenhague et le Dr D. Defaye du MNHN, Paris, pour les recherches concernant le matériel de la collection Budde-Lund; Ms M. Lowe du BMNH, Londres pour le prêt de matériel de la collection Budde-Lund, les Drs P.T. Harding (Monks Wood Experimental Station), Huntingdon et D. Bilton (University of York), Heslington pour le prêt des échantillons récoltés en Irlande et en Grande-Bretagne. Ce travail a été effectué pour partie dans le cadre du programme communautaire «High endemism areas... » CEE n°EV5V-CT94-0435.



lobe externe de l'exopodite 1
dépourvu de lobule détaché
– crête sternale sur
l'ischion de P II
O. intermedius

– pas de crête sternale sur
l'ischion de P II
+ plage de soies apicales
sur la face antérieure
de l'ischion de P III
O. flavus

+ dépression apicale de
la face sternale de
l'ischion de P III
avec soies médio-sternales
O. violaceus

FIG. 43

Clé dichotomique discriminant les trois espèces *O. intermedius*, *O. flavus*, *O. violaceus*.

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Aleocharinae della Colombia e dell'Ecuador: Parte II (Coleoptera, Staphylinidae)

(132° Contributo alla conoscenza delle Aleocharinae)

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Aleocharinae from Colombia and Ecuador: Part II (Coleoptera, Staphylinidae). - Three species of the tribe Falagriini and thirty two of the tribe Athetini are described as new. The new genus *Cosmogastrusa* of the tribe Athetini is described and illustrated. Its relationships with *Aloconota* Thomson and *Pelioptera* Kraatz are discussed. *Falagria munda* Erichson is transferred to *Gnypeta* Thomson. *Atheta parciior* sensu Pace, 1987, from Guadalupa (nec *Atheta parciior* Bernhauer, 1927, from Argentina) is recognised as a different species and is called *Atheta (Acrotona) semilacera* sp. n.

Key-words: Coleoptera - Staphylinidae - Aleocharinae - Taxonomy - Colombia - Ecuador - Guadeloupe.

INTRODUZIONE

Anche le nuove specie descritte nella presente seconda parte del lavoro sulle Aleocharinae della Colombia e dell'Ecuador, come quelle descritte nella prima parte pubblicata sulla "Revue suisse de Zoologie" nell'anno 1996, appartengono al materiale raccolto dal Dr H.G. Müller di Giessen, affidatomi in esame tramite il Dr V. Puthz della "Limnologische Flusstation" di Schlitz. Pure qui sono aggiunte delle specie dell'Ecuador raccolte dal Dr L. Bartolozzi del Museo Zoologico de "La Specola" dell'Università di Firenze e dal Prof. Dr H. Franz di Mödling. E' pure compreso un lotto proveniente da vecchie collezioni del Museo Zoologico dell'Università Humboldt di Berlino, avuto in esame grazie alla cortesia del Dr M. Uhlig.

Per le specie non nuove, appartenenti alle tribù qui trattate, rimando all'elenco dato nella prima parte.

Gli holotipi delle nuove specie qui descritte sono conservati nel "Muséum d'Histoire Naturelle" di Ginevra (MG), nello "Zoologische Museum" dell'Università Humboldt di Berlino, in collezione del Prof. Dr H. Franz (CFR) e nel Museo Zoologico de "La Specola" dell'Università di Firenze (MF).

DESCRIZIONI

FALAGRIINI

Falagria (Lissagria) uniformis sp. n. (Figg. 1–2)

TIPO. Holotypus ♀, Ecuador, Cotopaxi, loc. Naranchito, 2000 m, C/O S. Francisco de Las Pampas, 3.II.1993, (L. Bartolozzi leg., N° 9830, MF).

DESCRIZIONE. Lunghezza 4,4 mm. Corpo lucido e nero; antenne nere con antennumero basale giallo e l'undicesimo con apice nero-bruno; zampe gialle. Il capo presenta punteggiatura fitta e superficiale, assente sulla linea mediana e molto fine all'indietro: vi è un solco mediano posteriore. Il pronoto mostra punteggiatura assai svanita e fine e un solco mediano profondo, confluyente all'indietro, in una fossetta delimitata a ciascun lato da un punto profondo. Le elitre presentano tubercoletti fini, fitti e ben distinti solo alla base: sul resto della superficie i tubercoletti sono ancor più fini, meno fitti e superficiali all'indietro. Lo scutello è rugoso. L'addome, come il resto del corpo non presenta reticolazione; è coperto di punteggiatura distinta. Spermateca fig. 2.

COMPARAZIONI. In base alla forma della spermateca, la nuova specie si colloca tassonomicamente vicino a *F. laticeps* (Notman, 1920) del Nordamerica. Ne è distinta perché la parte distale della spermateca è più lunga; inoltre i penultimi antennumeri sono trasversi e non lunghi quanto larghi come in *laticeps*. Il capo ha un'impressione occipitale, assente in *laticeps* e il solco mediano del pronoto è profondo (e non superficiale come in *laticeps*).

Gnypeta pannosa sp. n. (Figg. 3–6)

TIPI. Holotypus ♂, Kolumbien, Punta de Betin, Sta. Marta, 1–26.IV.1986, Lichtfalle und Farbschalen, (Müller leg., MG).

Paratypi: 1 ♂ e 3 ♀ ♀, stessa provenienza, ma anche in data 9.V.1986.

DESCRIZIONE. Lunghezza 1,9 mm. Corpo lucido e bruno; uriti liberi primi e secondo giallo-bruni, ma il secondo porta una macchia bruna mediana; antenne brune con antennumero basale bruno-rossiccio; zampe di un giallo sporco. Sul corpo non vi è traccia di reticolazione. Il capo e il pronoto presentano una superficie coperta di tubercoletti distinti. La punteggiatura delle elitre è assai svanita. Edeago figg. 4–5, spermateca fig. 6.

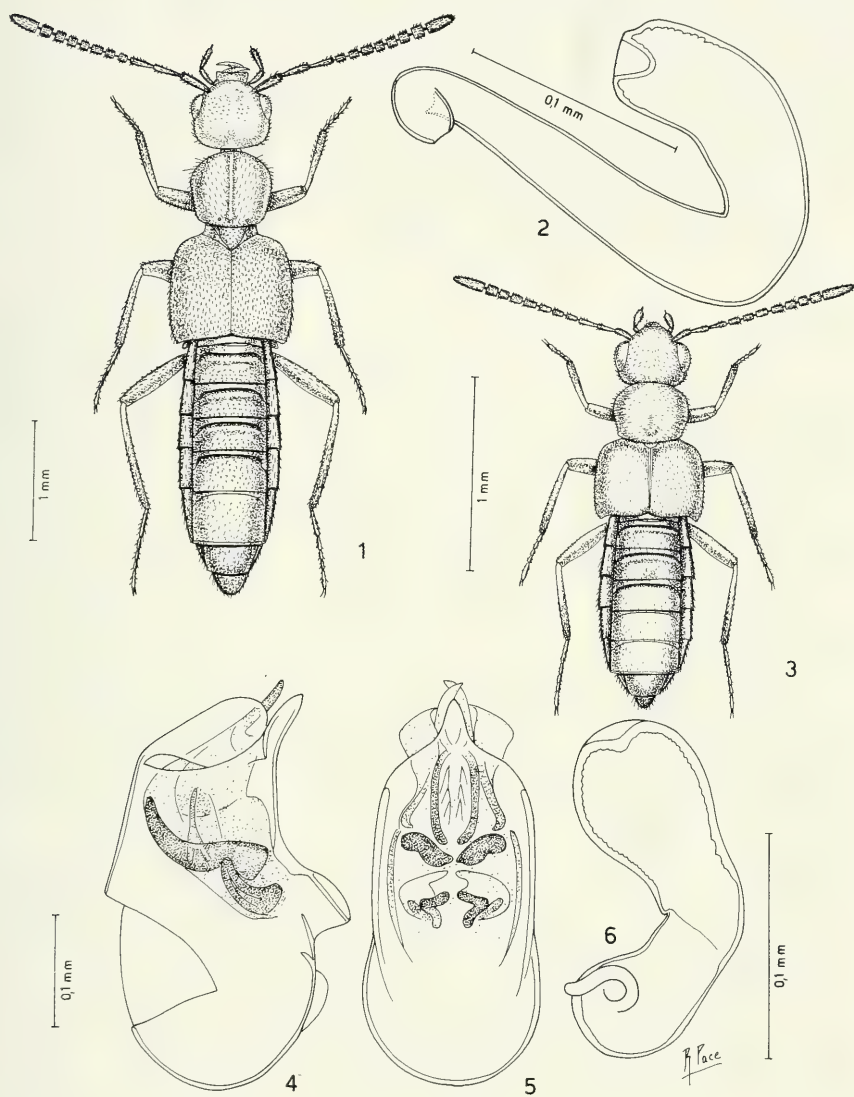
COMPARAZIONI. Specie simile esternamente a *G. boliviana* Bernhauer, 1909, della Bolivia, che mi è nota solo sull'holotypus ♀. La spermateca corta distingue nettamente la nuova specie da *boliviana* che ha spermateca molto sviluppata e a forma della lettera S.

Gnypeta chibchaorum sp. n. (Figg. 7–10)

TIPI. Holotypus ♂, Kolumbien, Punta de Betin, Sta. Marta, 1–26.IV.1986, Lichtfalle und Farbschalen, (Müller leg., MG).

Paratypi: 3 ♂ ♂ e 2 ♀ ♀, stessa provenienza.

DESCRIZIONE. Lunghezza 2,0 mm. Corpo lucido e nero-bruno; uriti liberi primo e secondo bruni; antenne brune con i due antennumeri basali di un giallo sporco;



FIGG. 1-6

Habitus, spermateca ed edeago in visione laterale e ventrale. 1-2: *Falagria (Lissagria) uniformis* sp. n.; 3-6: *Gnypeta pannosa* sp. n.

zampe gialle. L'avancorpo è coperto di reticolazione distinta; l'addome è senza reticolazione. La punteggiatura o i tubercoletti dell'intero corpo sono indistinti. La fronte è impressa. Edeago figg. 8-9, spermateca fig. 10.

COMPARAZIONI. Specie differente da *G. munda* (Erichson, 1840) (**comb. n.**, "olim" *Falagria munda* Er.), del Brasile, per avere gli antennumeri 4° a 6° molto meno allungati e l'edeago meno sviluppato, con pezzi copulatori meno complessi di quelli osservabili nell'edeago dell'*holotypus* di *munda*.

ETIMOLOGIA. Dai Chibcha, popolazione colombiana stanziata al tempo della conquista spagnola.

ATHETINI

Cosmogastrusa gen. n.

(Figg. 11-17)

Genere che si colloca tra i generi *Aloconota* Thomson, 1858 e *Pelioptera* Kraatz, 1857. Tempie non marginate; palpi labiali di 3 articoli; ligula divisa in due lembi triangolari, fig. 15; palpi mascellari di 4 articoli, fig. 14; mento con margine anteriore appena arcuato all'indietro, fig. 17; processo mesosternale largo all'apice che è tronco, sicché le mesocoxe sono largamente separate tra loro; zampe anteriori spinose al lato esterno, fig. 16; formula tarsale 4-5-5; primo tarsomero posteriore corto; uroterghi liberi secondo a quinto impressi sulla linea mediana.

TYPUS GENERIS: *Cosmogastrusa curticornis* sp. n.

Etimologia. Il nome del nuovo genere significa: "Coei che ha ornamenti addominali".

COMPARAZIONI. Il nuovo genere presenta ligula simile a quella del generi *Aloconota* Thomson e *Pelioptera* Kraatz, ma le tibie anteriori spinose, le antenne cortissime, la pubescenza del pronoto diretta all'indietro, il primo tarsomero posteriore corto e le impressioni mediane degli uroterghi permettono di distinguere il nuovo genere dai due citati sopra.

Cosmogastrusa curticornis sp. n.

(Figg. 11-17)

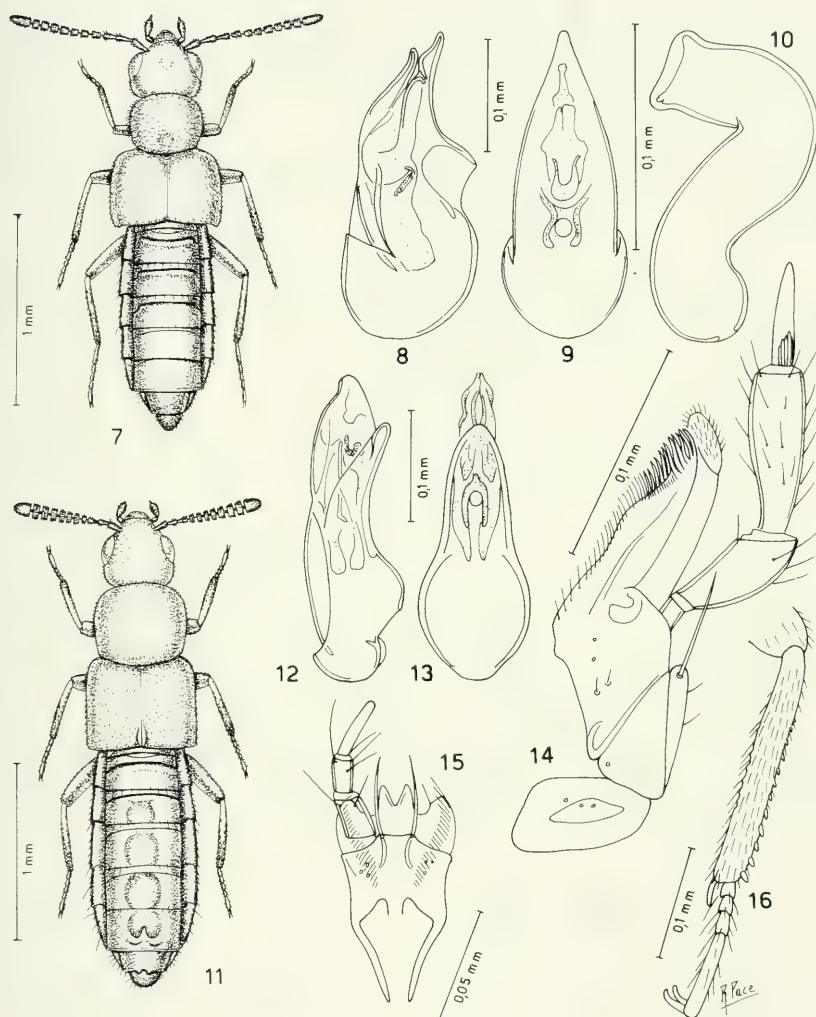
TIPO. Holotypus ♂, Kolumbien, Dept. Magdalena, Bahia de Nenguangue, Tayrona Park, ca. 25 Km nörd-östl. Sta. Marta, 30.IX.1985, aus der Vegetation, (Müller leg., MG).

DESCRIZIONE. Lunghezza 2,8 mm. Corpo lucido e rossiccio; capo e uriti liberi terzo, quarto e quinto bruno-rossicci; antenne brune con i tre antennumeri basali giallo-rossicci; zampe giallo-rossicce. La reticolazione del capo e delle elitre è estremamente svanita, quella del pronoto e dell'addome è assente. La punteggiatura del capo è superficiale, quella del pronoto indistinta e quella delle elitre ben distinta. La sutura delle elitre del maschio, posteriormente è sollevata a cercine. L'addome presenta dal secondo al quinto degli uroterghi liberi una profonda impressione a fondo concavo, reticolazione netta sul quinto urotergo libero e reticolazione vigorosa sul sesto. Edeago figg. 12-13.

Atheta (Chaetida) leda sp. n.

(Figg. 18-19)

TIPO. Holotypus ♀, Kolumbien, Dept. Magdalena, nördl. Sierra Nevada de Sta. Marta, ca. 2100 m, 24.VIII.1985, aus Moos und Streu, (Müller leg., MG).



FIGG. 7-16

Habitus, eedeago in visione laterale e ventrale, spermateca, labio con palpo labiale, maxilla con palpo mascellare e protibia con protarsi. 7-10: *Gnypeta chibchaorum* sp. n.; 11-16: *Cosmogastrusa curticornis* gen. n., sp. n.

DESCRIZIONE. Lunghezza 3,8 mm. Corpo lucido e nero-bruno; elitre ed estremità addominale brune; antenne nere con metà distale dell'undicesimo antenno-mero giallo-rossiccio e metà basale rossiccio; zampe rossicce con metà distale dei femori bruno-rossiccio. La reticolazione del capo e del pronoto è netta, quella delle elitre è svanita e quella dell'addome è a distinte maglie trasverse. Il capo e il pronoto presentano una superficie coperta di tubercoletti evidenti. I tubercoletti che coprono le elitre sono distinti. Spermateca fig. 19.

COMPARAZIONI. La nuova specie è distinta da *A. heterocera* Sharp, 1883, del Guatemala, per avere il quarto antenno-mero molto più lungo che largo (trasverso in *heterocera*); da *A. cognata* Sharp, 1883, del Guatemala, per avere il decimo antenno-mero più lungo che largo e non lungo quanto largo e il pronoto più trasverso; da *A. leucoptera* Sharp, 1883, del Guatemala, per avere le elitre brune e non di colore giallo pallido come in *leucoptera* e per la metà distale dell'undicesimo antenno-mero giallo-rossiccio. La nuova specie è distinta anche da *A. peruviana* Pace, 1986, del Perù, perché la sua spermateca è più breve di un terzo.

***Atheta (Acrotona) muellerina* sp. n.**

(Figg. 20–23)

TIPI. Holotypus ♂, Kolumbien, Villa Culebra bei Bonda, ca. 10 Km E Sta. Marta, XI–XII.1985, Barberfallen, (Müller leg., MG).

Paratypi: 1 ♂ e 4 ♀, stessa provenienza; 3 ♂♂, Kolumbien, Punta de Betin, Sta. Marta, XI–XII.1985, IV.1986, 1–10.V.1986, Farbschalen, (Müller leg.).

DESCRIZIONE. Lunghezza 1,7 mm. Corpo lucido e bruno scuro; elitre giallo-brune; antenne nere con i due antenno-meri basali bruni; zampe gialle. La reticolazione dell'avancorpo è assente, quella dell'addome è a maglie trasverse svanite. Il capo presenta tubercoletti fitti e superficiali, il pronoto e le elitre hanno superficie coperta di tubercoletti distinti. Edeago fig. 21–22, spermateca fig. 23.

COMPARAZIONI. Specie affine ad *A. parciur* Bernhauer, 1927, dell'Argentina, ma ha habitus più slanciato. L'edeago della nuova specie è meno sviluppato di quello di *parciur* e più ricurvo al lato ventrale. La spermateca della nuova specie descrive due spire e mezza, mentre quella di *parciur* una spira e mezza.

***Atheta (Acrotona) aequatorensis* sp. n.**

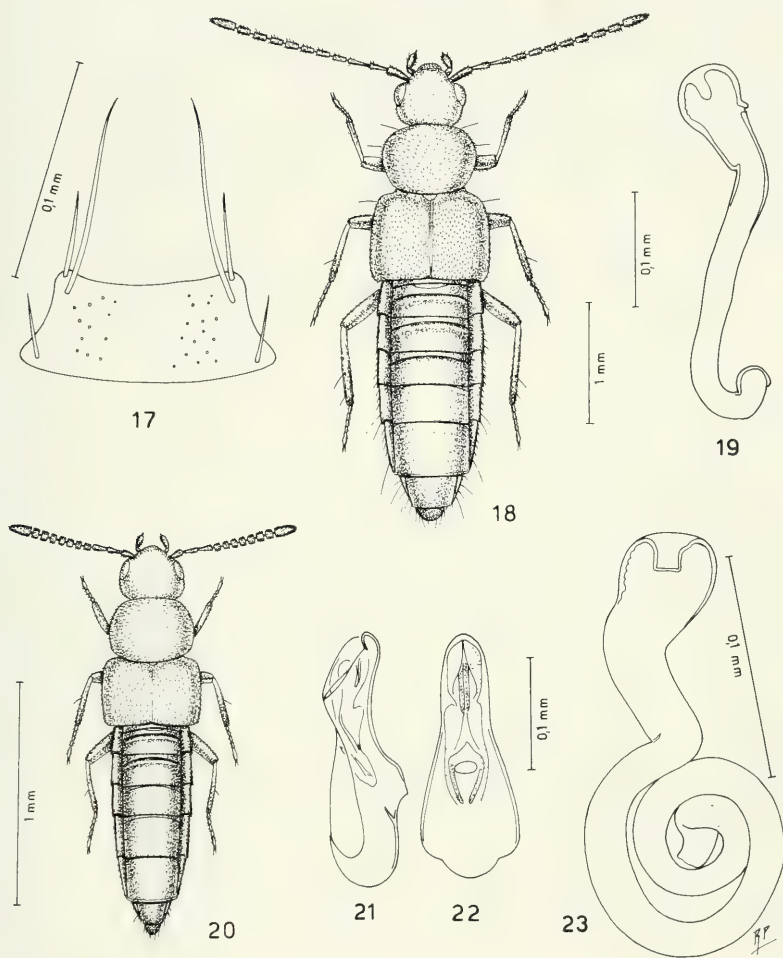
(Figg. 24–27)

TIPI. Holotypus ♂, Ecuador, Playa Tanga b. Guayaquil, IV.1975, (H. Franz leg., CFR).

Paratypi: 3 ♂♂ e 1 ♀, stessa provenienza.

DESCRIZIONE. Lunghezza 2,4 mm. Corpo lucidissimo e bruno; pronoto bruno-rossiccio; margine posteriore del quinto urotergo libero rossiccio; antenne brune con antenno-mero basale rossiccio e l'undicesimo giallo-rossiccio; zampe gialle. Assente è la reticolazione sul corpo. I tubercoletti della superficie del capo e delle elitre sono superficiali, quelli del pronoto sono distinti, anche se fini. Edeago figg. 25–26, spermateca fig. 27.

COMPARAZIONI. L'habitus della nuova specie è simile a quello di *A. flavonigra* Bernhauer, 1908, del Paraguay, ma la spermateca della nuova specie ha grandezza quasi doppia, con introflessione apicale del bulbo distale più profonda. Nella serie tipica di *flavonigra* non è presente il maschio.



FIGG. 17-23

Mento, habitus, spermateca ed edeago in visione laterale e ventrale. 17: *Cosmogastrusa curticornis* gen. n., sp. n.; 18-19: *Atheta* (*Chaetida*) *leda* sp. n.; 20-23: *Atheta* (*Acrotona*) *muel-lerina* sp. n.

***Atheta (Acrotona) omega* sp. n.**

(Figg. 28–31)

TIPI. Holotypus ♂, Kolumbien, Dept. Magdalena, nördl. Sierra Nevada de Sta. Marta, Nähe San Lorenzo, ca. 2100 m, 21.VIII.1985, aus Moos und Streu, (Müller leg., MG).

Paratypi: 1 ♀, stessa provenienza; 1 ♀, Kolumbien, Nördl. Sierra Nevada de Sta. Marta, Nähe El Campano, ca. 1000 m, aus Fall-Laub, 20.IV.1986, (Müller leg.).

DESCRIZIONE. Lunghezza 2,2 mm. Corpo lucido e bruno; antenne brune con undicesimo antennumero giallo-rossiccio; zampe rossicce. La reticolazione del capo è assente, quella del pronoto e delle elitre è molto svanita, quella dell'addome è distinta. La punteggiatura del capo è fitta e distinta. I tubercoli della superficie del pronoto sono superficiali, quelli delle elitre sono fini e distinti. Spermateca fig. 29, edeago figg. 30–31.

COMPARAZIONI. La nuova specie è distinta da *A. parcior* Bernhauer, 1927, dell'Argentina, poiché ha edeago a profilo ventrale bisinuoso (e non arcuato come in *parcior*) e poiché la spermateca mostra due spire e non una e mezza come in *parcior*.

***Atheta (Acrotona) elvira* sp. n.**

(Figg. 32–33)

TIPO. Holotypus ♀, Kolumbien, nördl. Sierra Nevada de Sta. Marta, Nähe El Campano, ca. 1000 m, 20.IV.1986, aus Fall-Laub, (Müller leg., MG).

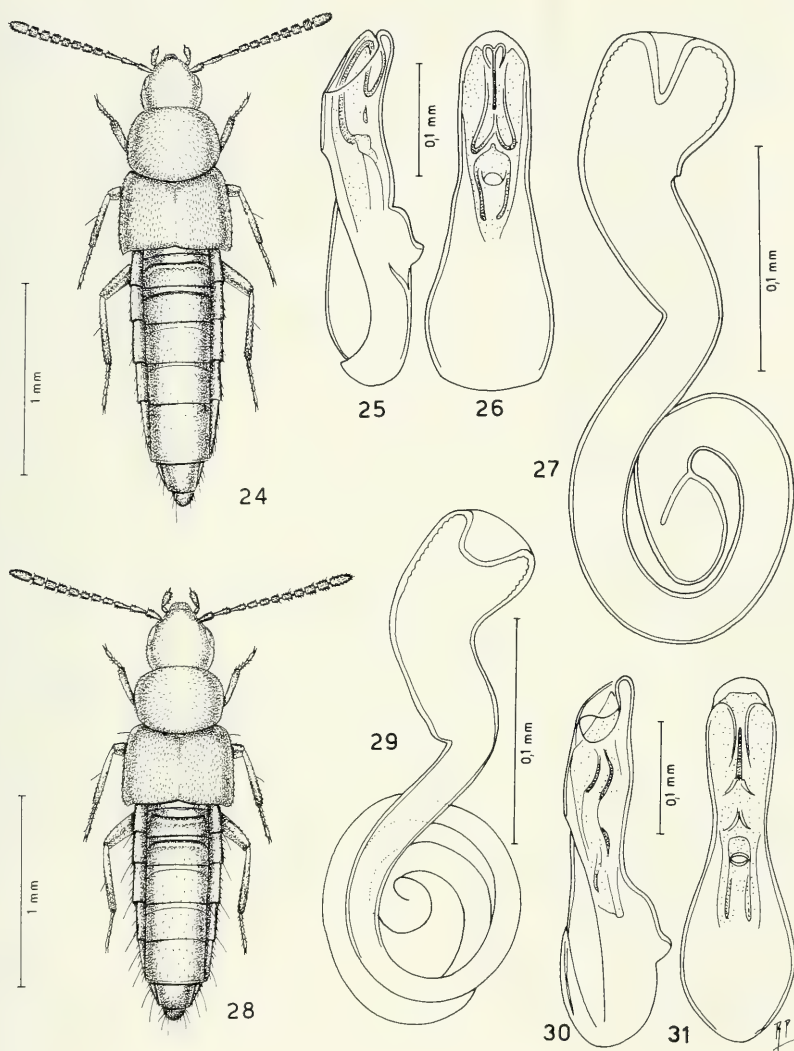
DESCRIZIONE. Lunghezza 1,8 mm. Corpo debolmente lucido e bruno; addome nero, tranne la base e l'apice che sono bruni; antenne brune con antennumero basale bruno-rossiccio; zampe giallo-brune. La reticolazione dell'avancorpo non è visibile, quella dell'addome è distinta, composta di maglie poligonali irregolari. La punteggiatura del capo è superficiale. I tubercoli che coprono la superficie del pronoto e delle elitre sono svaniti, quelli dell'addome sono poco salienti. Spermateca fig. 33.

COMPARAZIONI. La nuova specie, avendo le spire prossimali della spermateca invertite rispetto la norma, non è comparabile con nessuna specie della regione neotropica tranne una discussa nella nota che segue. In Cina e Giappone vive un'altra specie che possiede una spermateca con spire invertite: *A. neglecta* Cameron, 1933. Ma l'inflessione apicale del bulbo distale della spermateca della nuova specie è molto più profonda e la spira della spermateca stessa è stretta e non ampia come quella di *neglecta*.

ETIMOLOGIA. La nuova specie è dedicata a mia sorella Elvira, in segno di riconoscenza per la sua generosità disinteressata.

NOTA. Nel mio lavoro "Aleocharinae dell'Isola della Guadalupa (Antille)" pubblicato del 1987 in "Folia Entomologica Hungarica" compare il disegno dell'edeago e della spermateca di *Atheta (Acrotona) parcior* Bernhauer, 1927. Pur avendo comparato l'edeago di tre maschi della Guadalupa con l'edeago dell'holotypus di *parcior*, in quel periodo di tempo non conoscevo la forma della spermateca di *parcior*.

La differenza riscontrata tra l'edeago degli esemplari della Guadalupa e quella dell'holotypus di *parcior* l'attribuisco a variabilità locale della stessa specie. La scoperta successiva della spermateca di *parcior*, mi ha permesso di riconoscere che l'edeago e la spermateca pubblicati nel 1987, appartengono a una nuova specie che nomino *Atheta (Acrotona) semilacera* sp. n. (*Atheta parcior*, sensu Pace, 1987, nec *Atheta parcior* Bernhauer 1927).



FIGG. 24-31

Habitus, edeago in visione laterale e ventrale e spermateca. 24-27: *Atheta (Acrotona) aequatorensis* sp. n.; 28-31: *Atheta (Acrotona) omega* sp. n.

Atheta (Acrotona semilacera sp. n. risulta, in base alla forma della spermateca con spira invertita, affine ad *Atheta (Acrotona) elvira* sp. n. sopra descritta e ad *A. parciur*. Queste tre specie si distinguono per i caratteri dati nella seguente chiave:

- 1 – Pronoto molto trasverso; elitre molto lunghe: loro sutura lunga quanto il pronoto; spermateca con spire normali, cioè ad andamento antiorario. Argentina e Cile. *parciur* Bernhauer
- Pronoto poco trasverso; elitre corte: loro sutura nettamente più corta del pronoto; spermateca con spire ad andamento in senso orario. 2
- 2 – Occhi meno sviluppati, più corti delle tempie; reticolazione degli uriti a maglie lievemente trasverse e svanite; larga e tozza è l'introflessione apicale del bulbo distale della spermateca. Guadalupa. *semilacera* sp. n.
- Occhi più sviluppati, lunghi quanto le tempie; reticolazione degli uriti a maglie poligonali irregolari distinte; profonda e acuta è l'introflessione apicale del bulbo distale della spermateca. Colombia. *elvira* sp. n.

***Atheta (Acrotona) caranquina* sp. n.**

(Figg. 34–37)

TIPO. Holotypus ♂, Ecuador, Playa Tanga b. Guayaquil, IV.1975, (H. Franz leg., CFR).

DESCRIZIONE. Lunghezza 3,0 mm. Avancorpo debolmente lucido, addome lucido. Corpo bruno-rossiccio; antenne brune con antennumero basale rossiccio; zampe giallo-rossicce. La reticolazione del capo è quasi vigorosa, quella del pronoto è nettissima, quella delle elitre è distinta e quella dell'addome è a maglie molto trasverse e assai svanite: solo alla base di ciascun urotergo la reticolazione è netta e molto trasversa. La punteggiatura del capo è appena distinta e ciascun punto è grande. Sul pronoto non sono visibili né punteggiatura né tubercoletti. Tubercoletti fini coprono la superficie delle elitre. Edeago figg. 35–36, sesto urotergo libero del maschio fig. 37.

COMPARAZIONI. La nuova specie è distinta da *A. walteri* Bernhauer, 1908, del Brasile, per avere l'edeago più sviluppato e più profondamente ricurvo al lato ventrale e per la presenza di due soli denti al margine posteriore del sesto urotergo libero del maschio (in *walteri* quattro denti di cui i mediani larghi).

ETIMOLOGIA. Da Caras, regno preincaico dell'Ecuador.

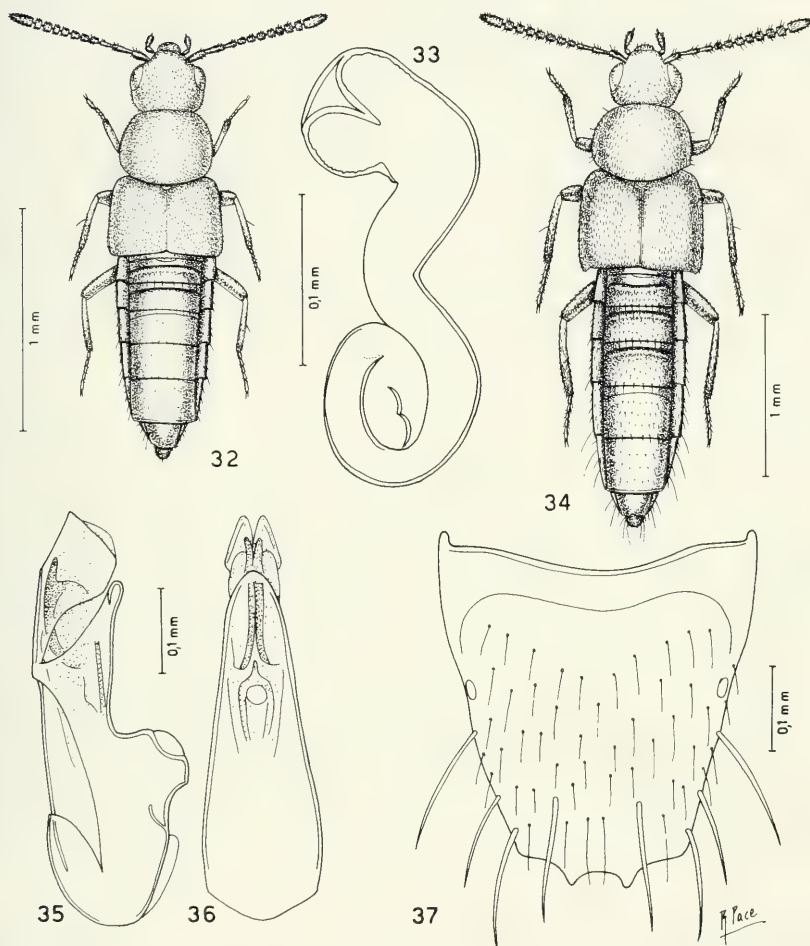
***Atheta (Acrotona) dimidiaticornis* sp. n.**

(Figg. 38–39)

TIPO. Holotypus ♀, Ecuador, Napo Rio Hollin, 9–13.II.1993, (L. Bartolozzi leg., N° 9840, MF).

DESCRIZIONE. Lunghezza 2,1 mm. Corpo lucido e nero pece; antenne nere con antennumeri 9° e 10° rossicci e l'undicesimo giallo; zampe gialle. L'avancorpo è privo di reticolazione, l'addome è coperto di reticolazione svanita. I tubercoletti che stanno sulla superficie del capo sono fini e fitti e danno un aspetto scabroso alla superficie. Il pronoto presenta tubercoletti fini e superficiali. Le elitre li ha pure superficiali, ma di dimensione maggiore. Spermateca fig. 39.

COMPARAZIONI. Specie sudamericane con il caratteristico colore delle antenne non sono state ancora segnalate.



FIGG. 32-37

Habitus, spermateca, edeago in visione laterale e ventrale e sesto urotergo libero del maschio.
 32-33: *Atheta (Acrotona) elvira* sp. n.; 34-37: *Atheta (Acrotona) caranquina* sp. n.

***Atheta (Acrotona) quitoensis* sp. n.**

(Figg. 40–41)

TIPO. Holotypus ♀, Ecuador, Strada Quito-Tandapi, 2550 m, 8.II.1993, (L. Bartolozzi leg., N° 9841, MF).

DESCRIZIONE. Lunghezza 2,2 mm. Corpo lucido. Capo nero; pronoto nero-bruno con margini laterali giallo-bruni; addome nero, tranne i margini posteriori degli uroterghi e la metà posteriore del quinto libero che sono nero-bruni; antenne brune con i due antennomeri basali bruni, il nono antennomero rossiccio e gli ultimi due gialli; zampe gialle. Le elitre sono andate perdute nella fase di raccolta. La reticolazione del capo e del pronoto è estremamente svanita, quella dell'addome è assente. Tuberoletti distinti e non molto fitti coprono la superficie del capo e del pronoto. Spermateca fig. 41.

COMPARAZIONI. La nuova specie ha spermateca simile a quella di *A. hoyoana* Scheerpeltz, 1972, dell'Argentina, ma la profonda introflessione apicale del bulbo distale della spermateca della nuova specie, tra l'altro, permette di distinguere la nuova specie da *hoyoana* che ha detta introflessione allo stato vestigiale.

***Atheta (Datomicra) shyria* sp. n.**

(Figg. 47–51)

TIPI. Holotypus ♂, Ecuador, Cotopaxi, 3500–4800 m, (H. Franz leg., CFR).

Paratipi: 3 ♂♂ e 1 ♀, stessa provenienza.

DESCRIZIONE. Lunghezza 2,1 mm. Corpo lucido e bruno; antenne nere; zampe giallo-brune. La reticolazione del capo è netta sul disco e svanita sul resto della superficie. La reticolazione del pronoto e dell'addome è svanita, quella delle elitre è distinta. La punteggiatura del capo è poco distinta. Il pronoto e le elitre presentano superficie coperta di tuberoletti svaniti.

COMPARAZIONI. Specie sistematicamente avvicinabile ad *A. columbica* Fauvel, 1901, della Colombia, a motivo della corta spermateca e dell'habitus simile. Tuttavia la nuova specie ha il bulbo distale della spermateca meno sviluppato del prossimale ed è privo di introflessione apicale, mentre il corrispondente bulbo in *columbica* è, al contrario, più sviluppato del prossimale e presenta una distinta introflessione apicale.

ETIMOLOGIA. Da Shyria, dinastia della popolazione Cara dell'Ecuador, nel 980 d. C.

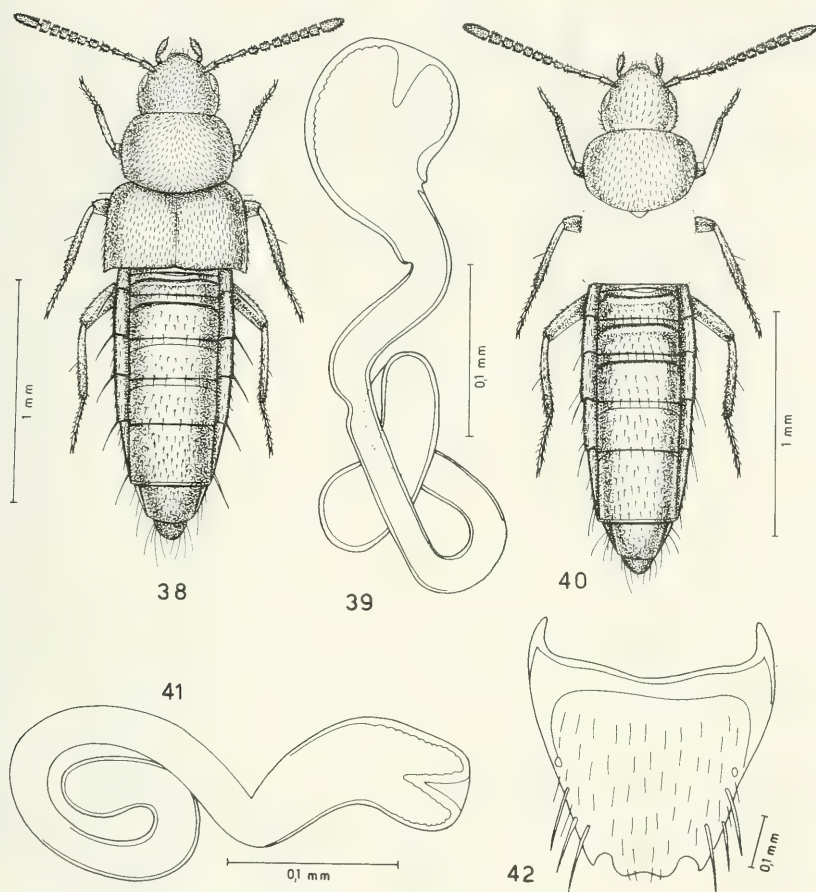
***Atheta (Datomicra) humboldti* sp. n.**

(Figg. 52–55)

TIPO. Holotypus ♂, Ecuador, Cotopaxi, 3500–4800 m, (H. Franz leg., CFR).

DESCRIZIONE. Lunghezza 1,8 mm. Corpo lucido e bruno, comprese le antenne; zampe gialle con femori bruni. La reticolazione del capo è netta sul disco e svanita sul resto della superficie. La reticolazione del pronoto è netta e quella delle elitre e dell'addome è distinta, sull'addome composta di maglie trasverse. I tuberoletti della superficie del pronoto e delle elitre sono superficiali. Edeago figg. 53–54, sesto urotergo libero del maschio fig. 55.

COMPARAZIONI. La nuova specie è simile alla precedente *A. shyria* sp. n. e ad *A. columbica* Fauvel, 1901, della Colombia. Ne è distinta per gli occhi ridotti e le elitre lunghe, rispetto la lunghezza del pronoto. L'edeago della nuova specie è meno

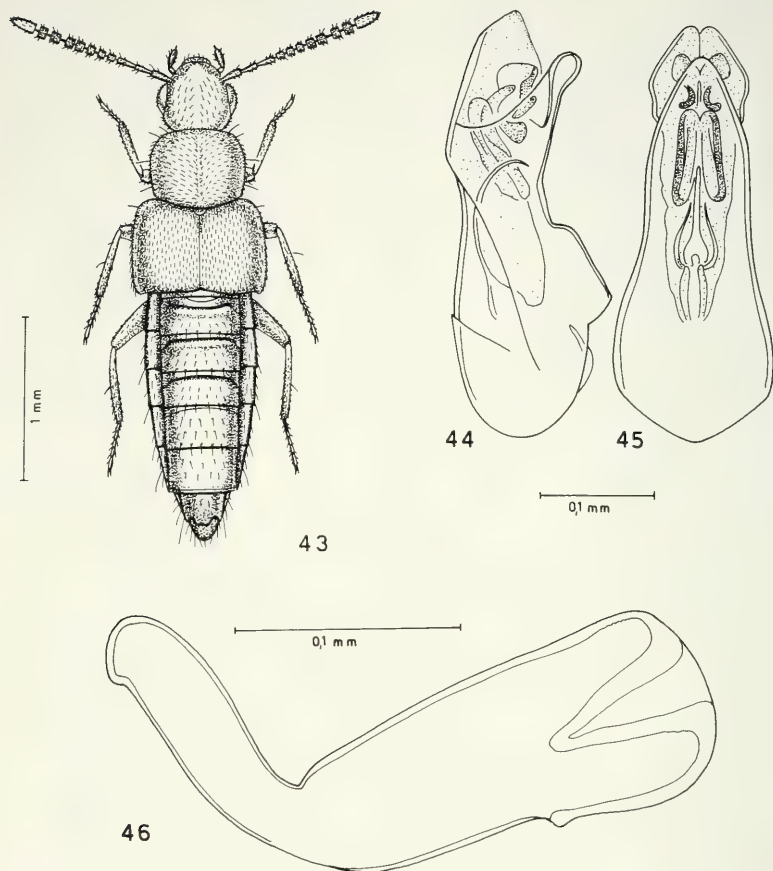


Figg. 38-42

Habitus, spermateca e sesto urotergo libero del maschio. 38-39: *Atheta (Acrotona) dimidiaticornis* sp. n.; 40-41: *Atheta (Acrotona) quitoensis* sp. n.; 42: *Atheta (Datomicra) conformis* (Erichson).

sviluppato e non ha la profonda concavità ventrale presente, al contrario, nell'edeago di *columbica*.

ETIMOLOGIA. Specie che prende nome da Alexander von Humboldt, celebre geografo e naturalista, che all'ombra del Cotopaxi da lui visitato, scrisse pagine ricche di scienza (1802).



FIGG. 43-46

Habitus, edeago in visione laterale e ventrale e spermateca. 43-46: *Atheta (Datomicra) conformis* (Erichson).

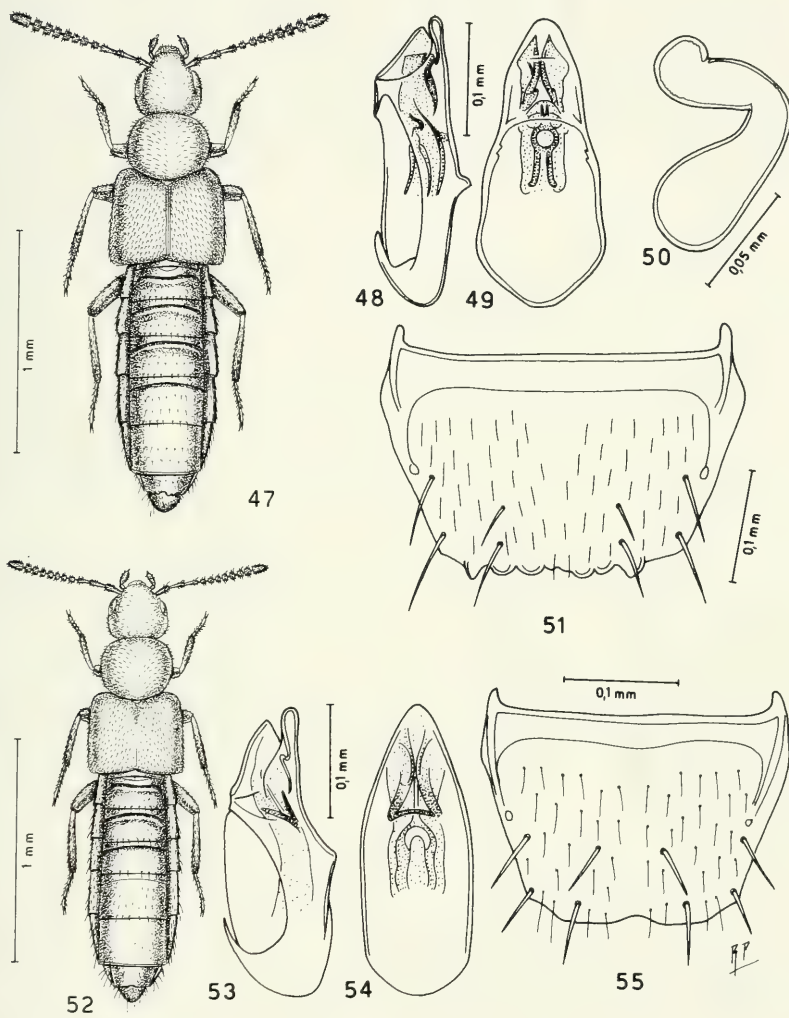
***Atheta (Datomicra) innexa* sp. n.**

(Figg. 56-59)

TIPI. Holotipus ♂, Nord-Kolumbien, Nördl. Sierra Nevada de Sta. Marta, Dep. Magdalena, San Lorenzo, 2200 m, 18-24.VIII.1985, Nadelwald Cupressus sp., (Müller leg., MG).

Paratypi: 22 es., stessa provenienza; 1 ♀ Nord-Kolumbien, Dept. Magdalena, nord-westl. Sierra Nevada de Sta. Marta, ca. 1000 m, Nähe San Pedro de la Sierra, 12.IV.1986, Krautschicht, (Müller leg.).

DESCRIZIONE. Lunghezza 2,7 mm. Corpo lucido e nero; addome bruno; antenne nere con antennumero basale bruno-rossiccio; zampe rossicce. L'avancorpo è coperto



Figg. 47-55

Habitus, edeago in visione laterale e ventrale, spermateca e sesto urotergo libero del maschio.
 47-51: *Atheta (Datomicra) shyria* sp. n.; 52-55: *Atheta (Datomicra) humboldti* sp. n.

di reticolazione netta e a maglie circolari. La reticolazione dell'addome è composta da maglie molto trasverse e nette. La punteggiatura del capo e delle elitre è distinta. Il pronoto è coperto di tubercoletti fini e distinti. Edeago figg. 57–58, spermateca fig. 59.

COMPARAZIONI. Specie che in base alla forma della spermateca è tassonomicamente vicina ad *A. columbica* Fauvel, 1901, della Colombia. Se ne distingue per avere il bulbo distale della spermateca nettamente flesso rispetto alla parte mediana, con introflessione apicale più profonda. In visione ventrale, l'edeago della nuova specie ha apice tronco e lievemente incavato, mentre l'apice dell'edeago di *columbica* è acuto.

***Atheta (Datomicra) culebra* sp. n.**

(Figg. 60–62)

TIPI. Holotypus ♂, Kolumbien, Villa Culebra bei Bonda, ca. 10 Km E Sta. Marta, XI–XII.1985, Barberfallen, (Müller leg., MG).

Paratypi: 4 ♂♂, stessa provenienza.

DESCRIZIONE. Lunghezza 1,7 mm. Corpo lucido e bruno; pronoto, base ed apice dell'addome bruno-rossicci; antenne brune con i due antenomeri basali giallo-rossicci; zampe gialle. Il capo e le elitre sono senza reticolazione. La reticolazione del pronoto e dell'addome è svanita; quella sull'addome è composta di maglie trasverse. La punteggiatura del capo e del pronoto è superficiale, quella delle elitre è distinta. Edeago figg. 61–62.

COMPARAZIONI. Specie distinta da *A. flavoterminalata* Cameron, 1923, della Giamaica, per avere l'edeago meno sviluppato, con un'incisione apicale (assente in *flavoterminalata*).

***Atheta (Datomicra) diducta* sp. n.**

(Figg. 63–64)

TIPI. Holotypus ♀, Nord-Kolumbien, Dept. Magdalena, nördl. Sierra Nevada de Sta. Marta, ca. 2100 m, 24.VIII.1985, aus Moos und Streu, (Müller leg., MG).

Paratypi: 2 ♀♀, idem, ma nahe San Lorenzo, ca. 2000 m, 20.VIII.1985, aus Moosrasen, (Müller leg.); 1 ♀, idem, ma nahe El Campano, ca. 1000 m, 20.IV.1986, aus Fall-Laub, (Müller leg.).

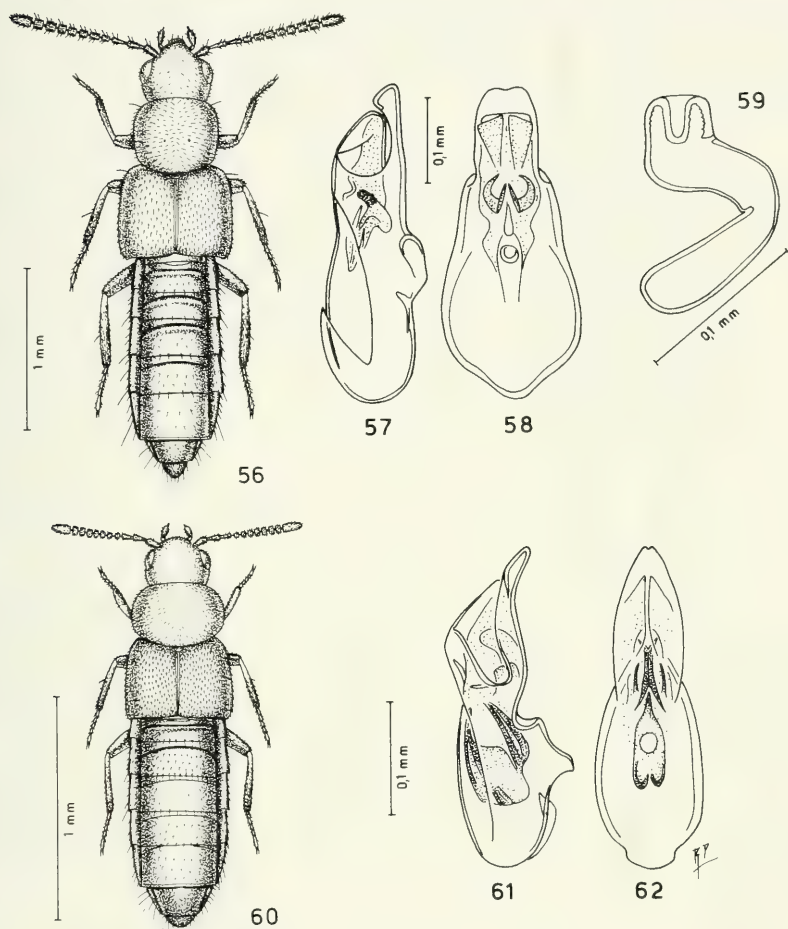
DESCRIZIONE. Lunghezza 2,1 mm. Corpo lucido e bruno; antenne nere con antennumero basale bruno-rossiccio e l'undicesimo giallo chiaro; zampe giallo-rossicce con femori debolmente oscurati. La reticolazione del capo è netta, quella del pronoto e delle elitre è distinta, quella delle elitre è a maglie molto trasverse svanite. La punteggiatura del capo è fitta, svanita e assente verso le tempie. Il pronoto ha un fine solco mediano. Spermateca fig. 64.

COMPARAZIONI. La nuova specie è ben distinta da *A. catamaricana* Bernhauer, 1925, dell'Argentina, per avere la spermateca tozza, con bulbo distale molto sviluppato e parte prossimale bruscamente ridotta di dimensioni (bulbo distale subsferico e di media grandezza e parte prossimale della spermateca ben sviluppata in *catamaricana*).

***Atheta (Datomicra) callicornis* sp. n.**

(Figg. 65–66)

TIPO. Holotypus ♀, Ecuador, Cotopaxi, S. Francisco de Las Pampas, 1300–1500 m, II.1993, (L. Bartolozzi leg., N° 9842, MF).



FIGG. 56-62

Habitus, edeago in visione laterale e ventrale e spermateca. 56-59: *Atheta (Datomicra) innexa* sp. n.; 60-62: *Atheta (Datomicra) culebra* sp. n.

DESCRIZIONE. Lunghezza 2,1 mm. Corpo lucido con deboli riflessi bronzeei e rossiccio scuro; elitre bruno-rossicce; quarto urite libero nero-bruno; antenne nero-brune con antennumero basale giallo, secondo antennumero giallo-bruno e l'undicesimo giallo paglierino; zampe gialle. La reticolazione del capo e delle elitre è distinta, quella del pronoto è svanita e quella dell'addome è assente. La punteggiatura del capo è superficiale. I tubercolotti presentati dal pronoto e dalle elitre sono poco distinti. Spermateca fig. 66.

COMPARAZIONI. Le ridotte dimensioni della spermateca della nuova specie permette di distinguere la nuova specie da *A. diducta* sp. n. sopra descritta e da *A. catamarcana* Bernhauer 1925, dell'Argentina. Ma altri numerosi caratteri distintivi sono osservabili, tra cui l'introflessione apicale del bulbo distale della spermateca della nuova specie a base molto larga.

***Atheta (Datomicra) chimborazensis* sp. n.**

(Figg. 67–69)

TIPO. Holotypus ♂, Ecuador, Chimborazo, 3600–4800 m, IV.1975 (H. Franz leg., CFR).

DESCRIZIONE. Lunghezza 2,6 mm. Corpo lucido e nero pece; antenne nere; zampe bruno-rossicce. Tutto il corpo è coperto di reticolazione netta: quella dell'addome è composta di maglie appena trasverse. La punteggiatura del capo e del pronoto è indistinta. Tubercoletti superficiali coprono le elitre. Edeago figg. 68–69.

COMPARAZIONI. La nuova specie è ben distinta da *A. catamarcana* Bernhauer, 1925, dell'Argentina, perché il suo edeago non presenta una lunga appendice ventrale ricurva che caratterizza l'edeago di *catamarcana*.

***Atheta (Datomicra) caraorum* sp. n.**

(Figg. 70–74)

TIPI. Holotypus ♂, Ecuador, Cotopaxi, 3500–4800 m, (H. Franz leg., CFR).

Paratypi: 10 es., stessa provenienza.

DESCRIZIONE. Lunghezza 2,4 mm. Corpo lucido e bruno; antenne brune con i due antenomeri basali rossicci; zampe rossicce. La reticolazione del capo, del pronoto e dell'addome è netta: quella dell'addome inoltre è a maglie lievemente trasverse. La reticolazione delle elitre è distinta. La punteggiatura del capo e del pronoto è indistinta. Tubercoletti superficiali coprono la superficie delle elitre. Edeago figg. 71–72, spermateca fig. 73, sesto urotergo libero del maschio fig. 74

COMPARAZIONI. La nuova specie è affine e ben distinta da *A. araucana* Pace, 1987, del Cile. L'edeago è molto più sviluppato e in visione ventrale nettamente più largo. La spermateca della nuova specie ha bulbo distale subsferico e non sub-trapezoidale come in *araucana*.

ETIMOLOGIA. Dalla popolazione Cara, che verso il 980 d. C. conquistò Quito.

***Atheta (Datomicra) shuarorum* sp. n.**

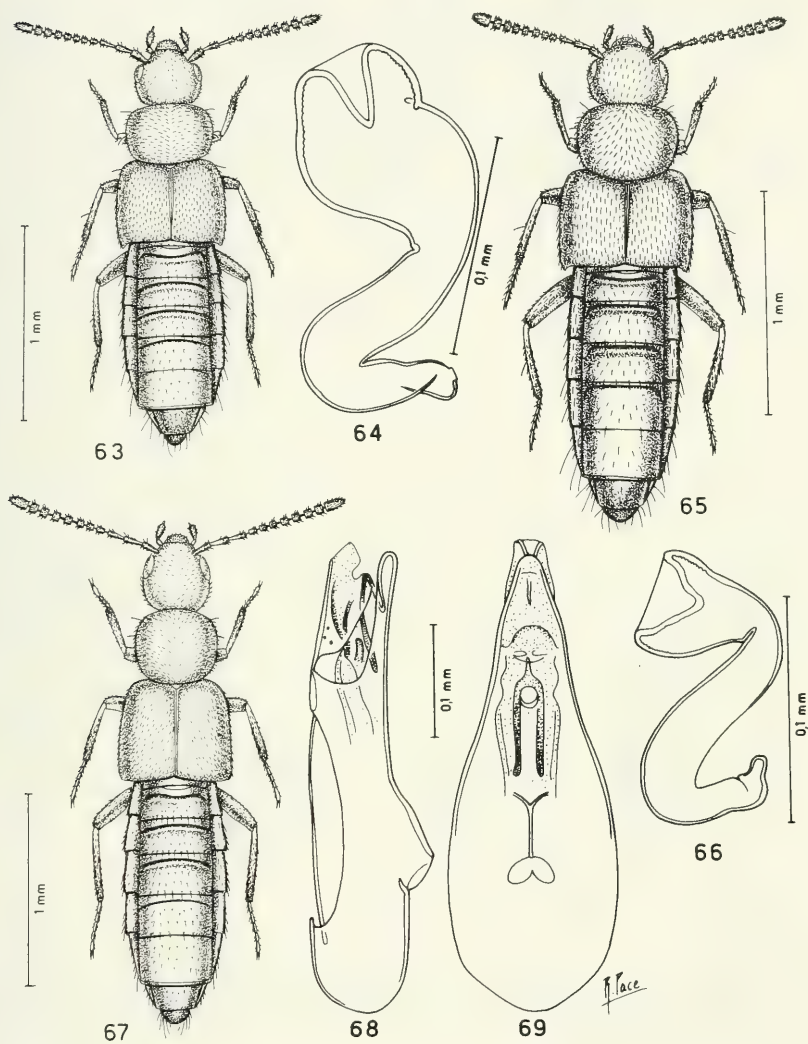
(Figg. 75–79)

TIPI. Holotypus ♂, Ecuador, Chimborazo, 3600–4800 m, IV.1975 (H. Franz leg., CFR).

Paratypi: 6 es., stessa provenienza.

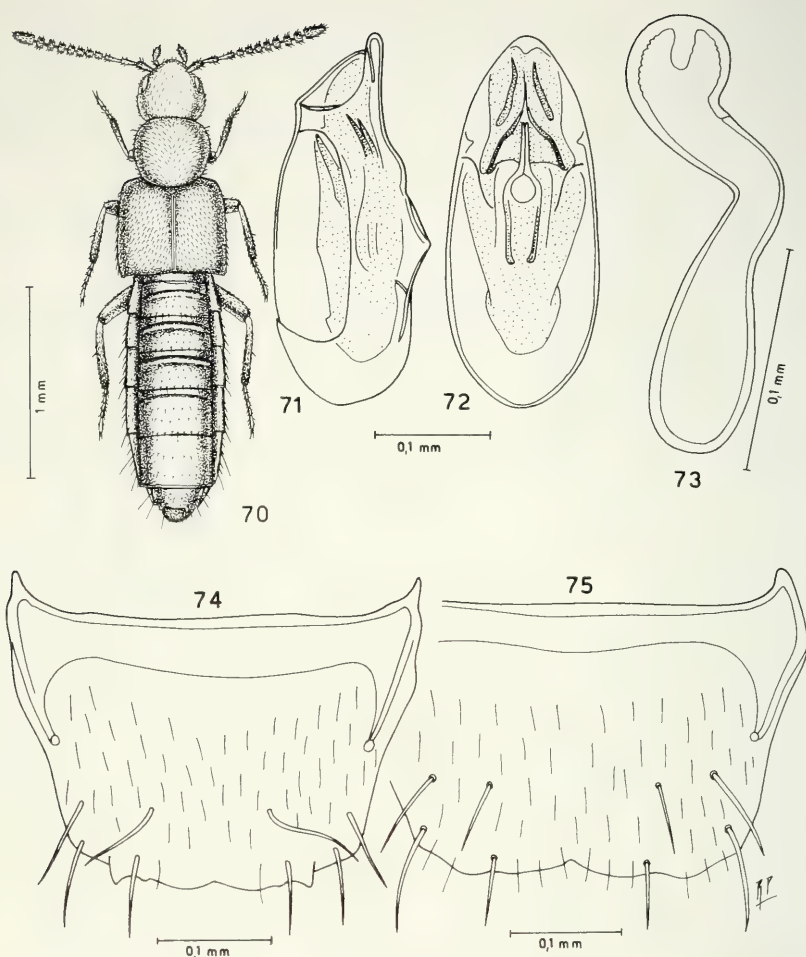
DESCRIZIONE. Lunghezza 2,6 mm. Corpo lucido e nero; antenne brune con antennumero basale bruno-rossiccio; zampe bruno-rossicce. La reticolazione del capo, del pronoto e dell'addome è netta: sull'addome è composta di maglie poligonali irregolari. La punteggiatura del capo e del pronoto è indistinta. Le elitre presentano tubercoletti confusi nella reticolazione della superficie. Sesto urotergo libero del maschio fig. 75, edeago figg. 77–78, spermateca fig. 79.

COMPARAZIONI. Specie simile alla precedente *A. caraorum* sp. n., da cui è distinta per la forma della spermateca, dell'edeago e del sesto urotergo libero del maschio. E' pure distinta da *A. araucana* Pace, 1987, del Cile, per i medesimi



FIGG. 63-69

Habitus, spermateca ed edeago in visione laterale e ventrale. 63-64: *Atheta (Datomicra) diducta* sp. n.; 65-66: *Atheta (Datomicra) callicornis* sp. n.; 67-69: *Atheta (Datomicra) chimborazensis* sp. n.



FIGG. 70-75

Habitus, edeago in visione laterale e ventrale, spermateca e sesto urotergo libero del maschio.
70-74: *Atheta (Datomicra) caraorum* sp. n.; 75: *Atheta (Datomicra) shuarorum* sp. n.

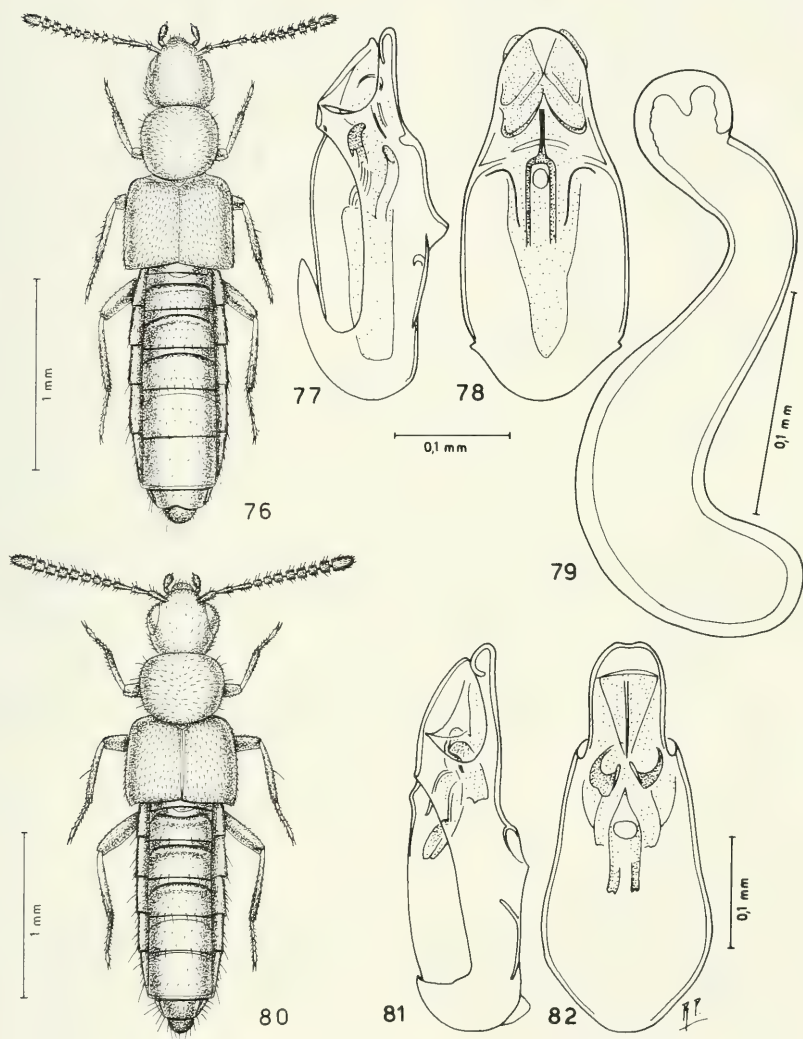
caratteri: tra l'altro il sesto urotergo libero del maschio non mostra denti evidenti al margine posteriore, mentre in *araucana* ne sono visibili quattro.

ETIMOLOGIA. Dagli Shuar o Jivaro, gruppo etnico dell'Amazzonia.

***Atheta (Datomicra) spinipes* sp. n.**

(Figg. 80-82)

TIPO. Holotypus ♂, Nord-Kolumbien, Dept. Magdalena, nördl. Sierra Nevada de Sta. Marta, San Lorenzo, 2200 m. 18-24.VIII.1985, am Wegrand aus der Vegetation, (Müller leg., MG).



FIGG. 76-82

Habitus, edeago in visione laterale e ventrale e spermateca. 76-79: *Atheta (Datomicra) shuarorum* sp. n.; 80-82: *Atheta (Datomicra) spinipes* sp. n.

DESCRIZIONE. Lunghezza 2,8 mm. Avancorpo lucido, addome lucidissimo. Corpo nero; elitre nero-brune; antenne nere con antennumero basale nero-bruno; zampe giallo-rossicce. L'intero corpo è coperto di reticolazione netta: quella dell'addome è a maglie molto trasverse, quella del capo a maglie circolari. I tubercoletti della superficie del capo sono radi e distinti, quelli del pronoto sono meno radi e quelli delle elitre sono quasi fitti. Le tibie anteriori al lato esterno presentano delle setole corte robuste simili a spine. Questo carattere ha suggerito il nome della specie. Edeago figg. 81–82.

COMPARAZIONI. Le tibie anteriori spinose al lato esterno, insieme alla debole incavatura apicale dell'edeago, permettono di distinguere la nuova specie da *A. obscuripennis* (Solier, 1849) del Cile, che non mostra tali caratteri e ha edeago meno sviluppato.

***Atheta (Datomicra) chibchana* sp. n.**

(Figg. 83–87)

TIPI. Holotypus ♂, Nord-Kolumbien, Dept. Magdalena, Nord Sierra Nevada de Sta. Marta, San Lorenzo, 2200 m, 18–24.VIII.1985, Nadelwald Cupressus sp., (Müller leg., MG).

Paratipi: 10 es., stessa provenienza.

DESCRIZIONE. Lunghezza 2,3 mm. Corpo lucido e nero; addome bruno; antenne nere con antennumero basale bruno; zampe giallo-rossicce. La reticolazione è netta solo sul disco del capo, sulle elitre e sull'addome: su quest'ultimo è composta di maglie molto trasverse. La reticolazione del pronoto è distinta. La punteggiatura del capo è superficiale e assente sulla linea mediana. I tubercoletti sparsi sul pronoto sono svaniti, quelli sulle elitre sono distinti. Edeago figg. 84–85, spermateca fig. 86, sesto urotergo libero del maschio fig. 87.

COMPARAZIONI. La forma dell'edeago della nuova specie ha caratteri comuni con quello di *A. baculum* Pace, 1990, dell'Argentina, ma la forma della spermateca è nettamente differente e l'undicesimo antennumero della nuova specie è molto lungo (breve in *baculum*).

ETIMOLOGIA. Dalla popolazione Chibcha che si stanziò sugli altipiani della Colombia al tempo della conquista spagnola.

***Atheta (Datomicra) sierrae* sp. n.**

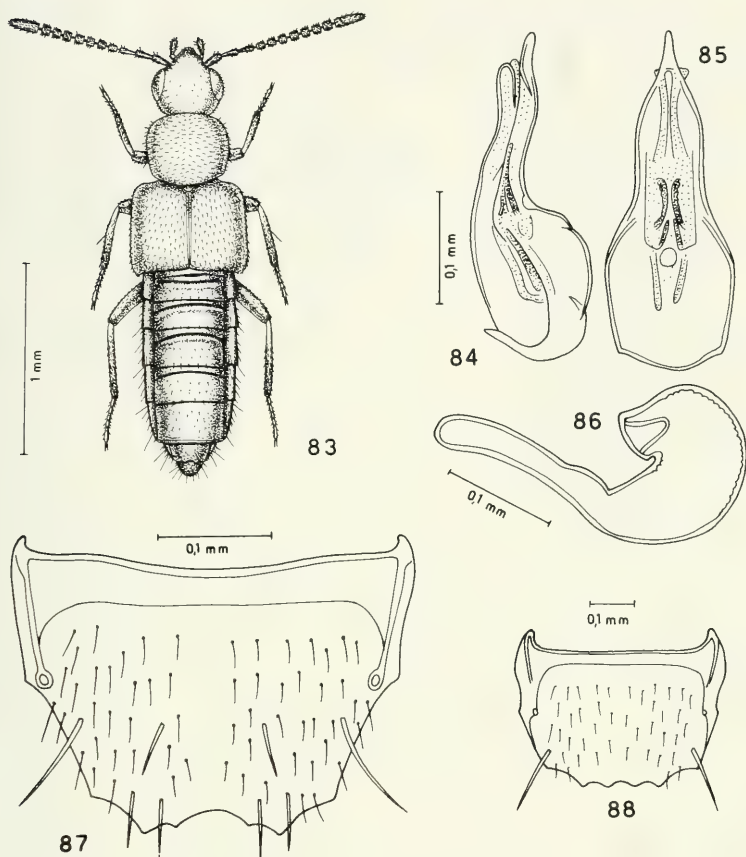
(Figg. 88–92)

TIPI. Holotypus ♂, Nord-Kolumbien, Dep. Magdalena, Nörd. Sierra Nevada de Sta. Marta, San Lorenzo, 2200 m, 18–24.VIII.1985, Nadelwald Cupressus sp., (Müller leg., MG).

Paratipi: 41 es., stessa provenienza.; 4 ♂♂, idem, ma 17–24.VIII.1985, viehweide Barberfallen, (Müller leg.).

DESCRIZIONE. Lunghezza 3,5 mm. Corpo lucido e nero; elitre bruno-rossicce; antenne nere con antennumero basale bruno-rossiccio; zampe giallo-rossicce. La reticolazione del capo, delle elitre e dell'addome è netta: quella sull'addome è a maglie molto trasverse. La punteggiatura del capo è assai superficiale. Quella del pronoto è svanita, come la reticolazione del fondo. La punteggiatura delle elitre è netta. Sesto urotergo libero del maschio fig. 88, edeago figg. 90–91, spermateca fig. 92.

COMPARAZIONI. La nuova specie è molto differente da *A. obscuripennis* (Solier, 1849), del Cile, sia per l'edeago che è molto più sviluppato, che per la spermateca che



FIGG. 83-88

Habitus, edeago in visione laterale e ventrale, spermateca e sesto urotergo libero del maschio.

83-87: *Atheta (Datomicra) chibchana* sp. n.; 88: *Atheta (Datomicra) sierrae* sp. n.

presenta introflessione apicale del bulbo distale enorme, sì da occupare tutto lo spazio interno del bulbo stesso.

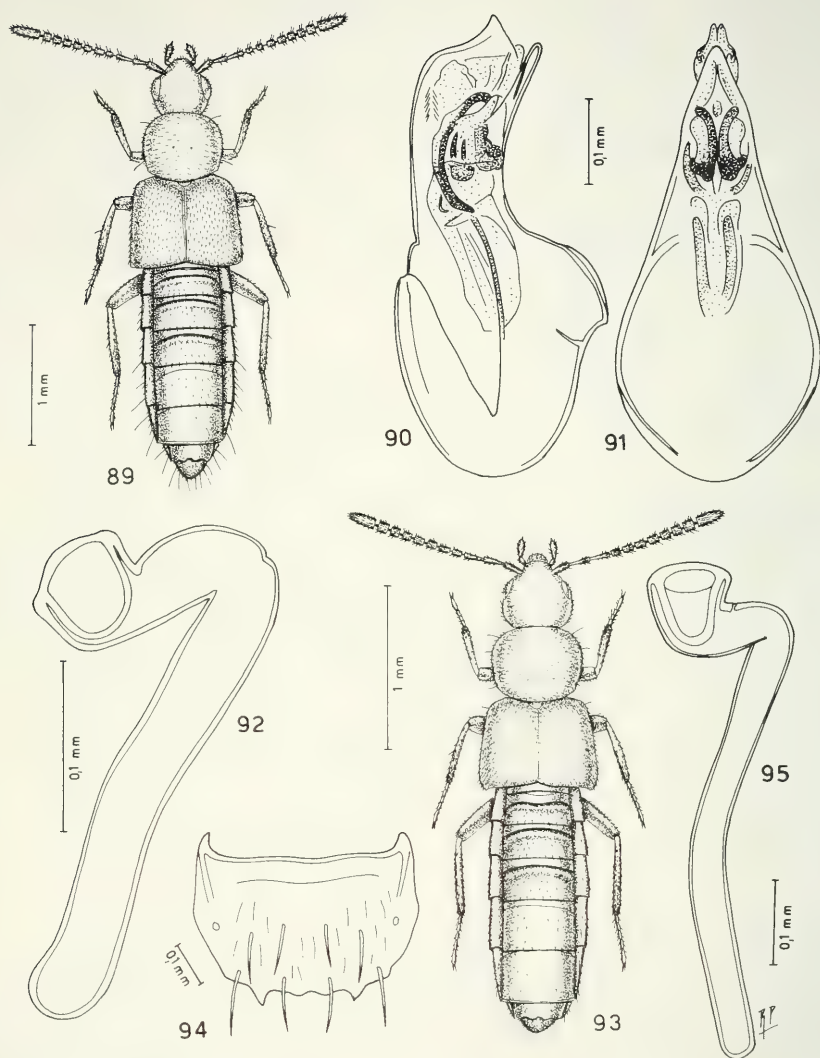
***Atheta (Datomicra) cotopaxiensis* sp. n.**

(Figg. 93-97)

Tipi. Holotypus ♂, Ecuador, Cotopaxi, 3500-4800 m, (H. Franz leg., CFR).

Paratypus: 1 ♀, stessa provenienza.

DESCRIZIONE. Lunghezza 2,9 mm. Corpo lucido, in avanti un po' appiattito. Corpo bruno-rossiccio; capo bruno; margine posteriore degli uroterghi rossiccio; antenne brune; zampe gialle. La reticolazione del capo e del pronoto è nettissima,



FIGG. 89-95

Habitus, edeago in visione laterale e ventrale, spermateca e sesto urotergo libero del maschio.
 89-92: *Atheta (Datomicra) sierrae* sp. n.; 93-95: *Atheta (Datomicra) cotopaxiensis* sp. n.

quella delle elitre e dell'addome è netta: su quest'ultimo è a maglie trasverse. La punteggiatura dell'avancorpo è estremamente svanita: sul capo è assente sulla linea mediana. Sesto urotergo libero del maschio fig. 94, spermateca fig 95, edeago figg. 96–97.

COMPARAZIONI. L'edeago della nuova specie presenta nel sacco interno robustissimi pezzi copulatori e la spermateca è molto sviluppata in lunghezza. Questi caratteri sono sufficienti a distinguere la nuova specie da *A. sierrae* sp. n. sopra descritta, a cui è affine, e da *A. obscuripennis* (Solier, 1849) del Cile che è tassonomicamente meno vicina.

***Atheta (Datomicra) nevadicola* sp. n.**

(Figg. 98–102)

TIPI. Holotypus ♂, Nord-Kolumbien, Dep. Magdalena, Nörd. Sierra Nevada de Sta. Marta, San Lorenzo, 2200 m, 18–24.VIII.1985, Nadelwald Cupressus sp., (Müller leg., MG).

Paratypi: 20 es., stessa provenienza, manche "am Wegrund aus Moos und Streu".

DESCRIZIONE. Lunghezza 3,7 mm. Corpo lucido e nero; margine posteriore degli uroterghi bruno-rossiccio; antenne nere con antennumero basale bruno-rossiccio; zampe giallo-rossicce. La reticolazione del capo e dell'addome è netta, quella del pronoto e delle elitre è nettissima. La punteggiatura del capo è svanita, quella del pronoto è fine e distinta e quella delle elitre è poco distinta. Edeago figg. 99–100, spermateca fig. 101, sesto urotergo libero del maschio fig. 102.

COMPARAZIONI. La nuova specie mostra affinità con *A. catamarcana* Pace, 1990, dell'Argentina, ma l'edeago della nuova specie è più tozzo, con bulbo basale molto largo, in visione ventrale. La spermateca della nuova specie ha parte prossimale molto più ricurva della medesima parte della spermateca di *catamarcana*.

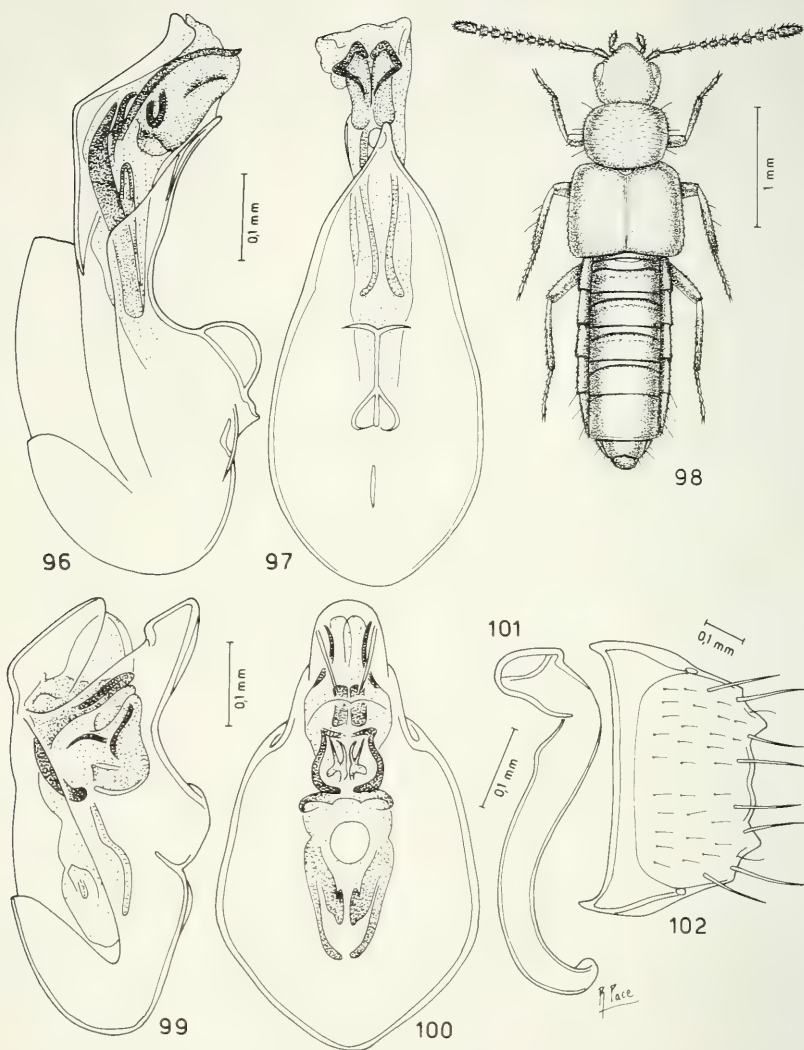
***Atheta (Datomicra) magdaleniensis* sp. n.**

(Figg. 103–106)

TIPO. Holotypus ♂, Nord-Kolumbien, Nörd. Sierra Nevada de Sta. Marta, Dep. Magdalena, San Lorenzo, 2200 m, 18–24.VIII.1985, Nadelwald, Cupressus sp., (Müller leg., MG).

DESCRIZIONE. Lunghezza 2,8 mm. Corpo lucido e nero; elitre giallo-brune; estremità addominale bruno-rossiccia; antenne interamente nere; zampe giallo-rossicce. La reticolazione del capo, del pronoto e dell'addome è netta: sull'addome in più è a maglie molto trasverse. La reticolazione delle elitre è vigorosa. La punteggiatura del capo è quasi indistinta. Il pronoto presenta una superficie coperta di tubercoli superficiali; le elitre presentano tubercoli salienti e fitti, con una pubescenza corta e fitta. Edeago figg. 104–105, sesto urotergo libero del maschio fig. 106.

COMPARAZIONI. La forma dell'edeago e i caratteri del margine posteriore del sesto urotergo libero del maschio, potrebbero indicare un'affinità tassonomica della nuova specie con *A. obscuripennis* (Solier, 1849), del Cile. Tuttavia l'edeago della nuova specie è maggiormente ricurvo al lato ventrale, con pezzi copulatori del sacco interno più sviluppati. Inoltre l'incavatura mediana del sesto urotergo libero del maschio è più ampia e il decimo antennumero è debolmente trasverso (molto trasverso in *obscuripennis*).



FIGG. 96-102

Edeago in visione laterale e ventrale, habitus, spermateca e sesto urotergo libero del maschio.
 96-97: *Atheta (Datomicra) cotopaxiensis* sp. n.; 98-102: *Atheta (Datomicra) nevadicola* sp. n.

***Atheta (Datomicra) hollinensis* sp. n.**

(Figg. 107–108)

TIPO. Holotypus ♀, Ecuador, Napo Rio Hollin, 1200 m, 9–13.II.1993, (L. Bartolozzi leg., N° 9845, MF).

DESCRIZIONE. Lunghezza 2,1 mm. Corpo lucido e nero; antenne nere con antennumero basale giallo sporco e secondo antennumero nero-bruno; zampe gialle. La reticolazione dell'avancorpo è distinta, quella dell'addome è a maglie molto trasverse e svanite. I tubercoli della superficie del capo sono svaniti e assenti sulla linea mediana; quelli del pronoto e delle elitre sono poco distinti. Spermateca fig. 108.

COMPARAZIONI. La caratteristica forma della spermateca, a tubulo sottile e piegata come nella lettera Z, distingue nettamente la nuova specie da *A. araucana* Pace, 1987, del Cile, che ha spermateca con tubulo di calibro maggiore ed è foggata a forma della lettera S allungata.

***Atheta (Datomicra) spirarum* sp. n.**

(Figg. 109–110)

TIPO. Holotypus ♀, Nord-Kolumbien, Sierra Nevada de Sta. Marta, San Lorenzo, 2200 m, 20.IV.1986, aus Fallaub und Moos, (Müller leg., MG).

DESCRIZIONE. Lunghezza 4,0 mm. Corpo lucidissimo e nero; elitre giallo-brunice; antenne brune con antennumero basale giallo-rossiccio; zampe gialle. La reticolazione del capo e delle elitre è distinta, quella del pronoto e dell'addome è molto svanita: quella dell'addome è composta di maglie molto trasverse. La punteggiatura del capo è svanita: ciascun punto è grande. Tubercoli fini e distinti coprono il pronoto. La punteggiatura delle elitre è distinta. Spermateca fig. 110.

COMPARAZIONI. La grande taglia corporea e la forma caratteristica della spermateca, con parte prossimale avvolta in quattros spire, sono caratteri distintivi unici nell'ambito del sottogenere.

***Atheta (Datomicra) chibcha* sp. n.**

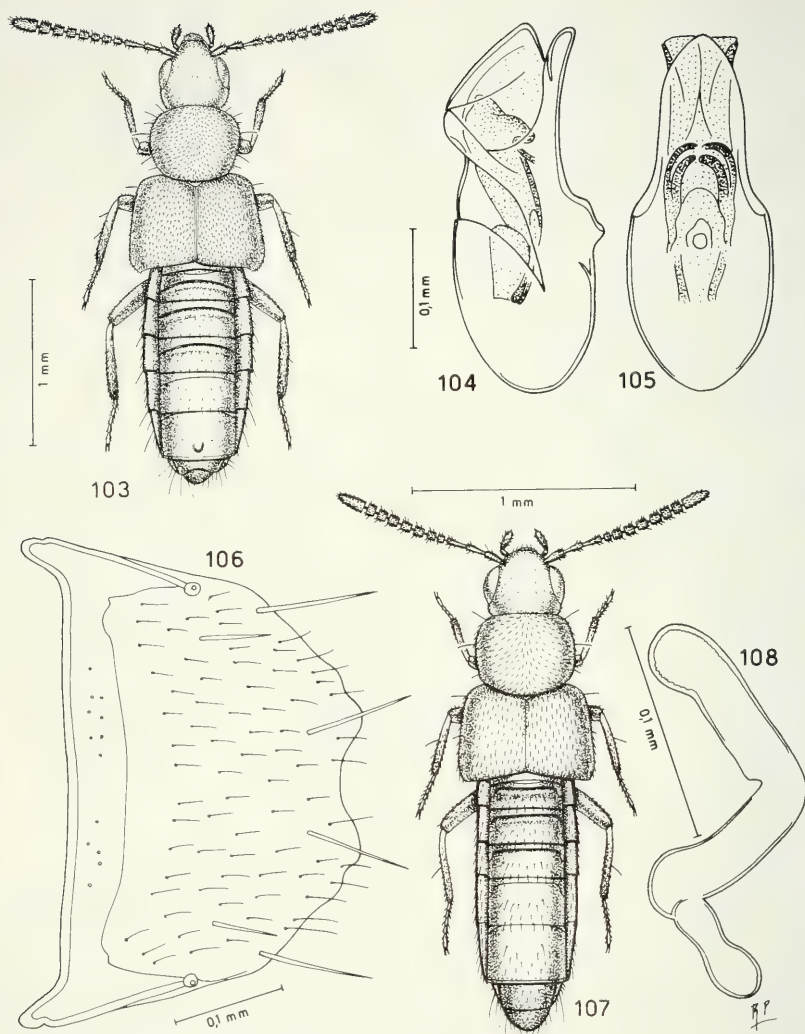
(Figg. 111–115)

TIPI. Holotypus ♂, Kolumbien, Villa Culebra bei Bonda, ca. 10 Km E Sta. Marta, XI–XII.1985, Barberfallen, (Müller leg., MG).

Paratypus: 1 ♀, stessa provenienza.

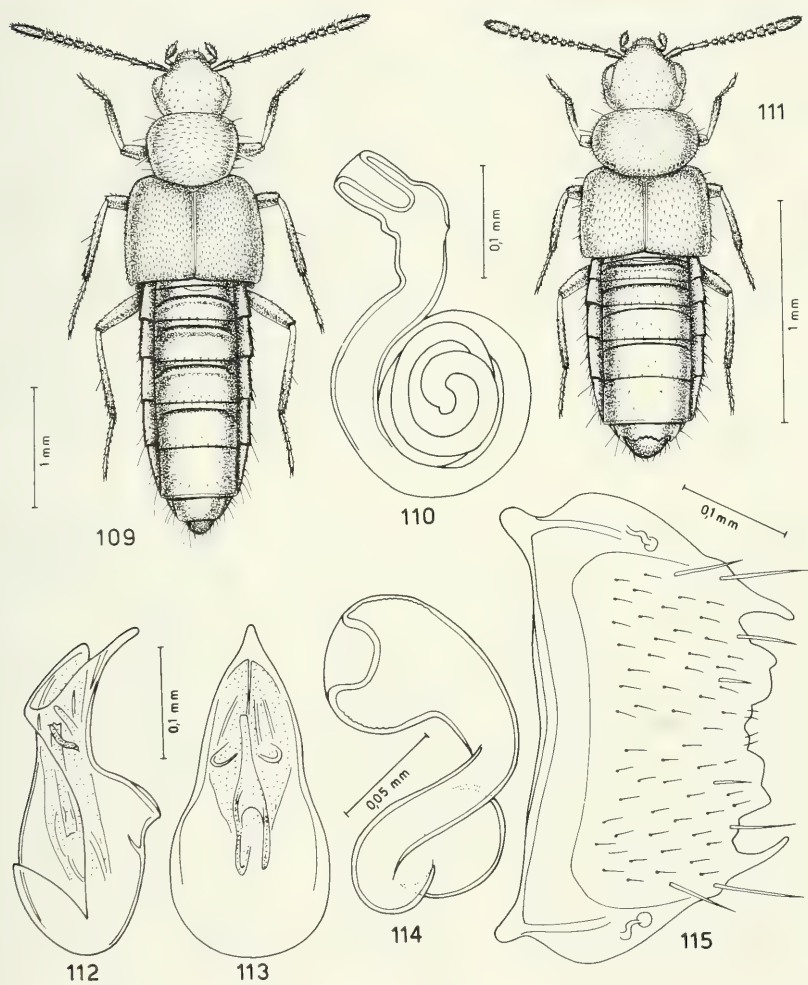
DESCRIZIONE. Lunghezza 1,8 mm. Corpo lucido. Capo, pronoto, metà posteriore delle elitre, uriti liberi terzo e quarto e metà basale del quinto, bruni, resto del corpo giallo-rossiccio; antenne brune con i due antennumeri basali giallo-rossicci; zampe giallo-rossicce. La reticolazione del capo e dell'addome è distinta: le maglie di reticolazione dell'addome sono un po' trasverse. La reticolazione del pronoto e delle elitre è netta. La punteggiatura del capo è svanita. I tubercoli della superficie del pronoto sono svaniti, quelli delle elitre sono distinti. Edeago figg. 112–113, spermateca fig. 114, sesto urotergo libero del maschio fig. 115.

COMPARAZIONI. La nuova specie è nettamente distinta da *A. columbica* Fauvel, 1901, della Colombia, per avere il pronoto più trasverso, l'edeago più profondamente ricurvo al lato ventrale, con pezzi copulatori del sacco interno evanescenti (ben netti, anche se sottili in *columbica*) e per la spermateca che ha un prolungamento prossimale (assente in *columbica*) e larga inflessione apicale del bulbo distale (strettissima inflessione in *columbica*).



FIGG. 103-108

Habitus, edeago in visione laterale e ventrale, sesto urotergo libero del maschio e spermateca.
 103-106: *Atheta (Datomicra) magdaleniensis* sp. n.; 107-108: *Atheta (Datomicra) hollinensis* sp. n.



FIGG. 109-115

Habitus, spermateca, edeago in visione laterale e ventrale e sesto urotergo libero del maschio.

109-110: *Atheta (Datomicra) spirarum* sp. n.; 111-115: *Atheta (Datomicra) chibcha* sp. n.

ETIMOLOGIA. La nuova specie prende nome dai Chobcha, gruppo etnico colombiano al tempo della conquista spagnola.

***Atheta (Datomicra) callimaculata* sp. n.**

(Figg. 116–117)

TIPO. Holotypus ♀, Ecuador, Cotopaxi, S. Francisco de Las Pampas, 1300–1500 m, II.1993, (L. Bartolozzi leg., N° 9843, MF).

DESCRIZIONE. Lunghezza 2,2 mm. Corpo lucido e giallo-rossiccio; elitre brune con base bruno-rossiccia; quarto urite libero con una macchia nero-bruna laterale che non raggiunge la base dell'urite stesso; antenne nero-brune con i due antennomeri basali, la base del terzo e l'undicesimo gialli; zampe gialle. La reticolazione del capo e del pronoto è estremamente svanita, quella delle elitre è distinta e quella dell'addome è composta di maglie ondulate trasverse e un po' svanite. Spermateca fig. 117.

COMPARAZIONI. La presenza di una macchia nero-bruna a ciascun lato del quarto urite libero, l'undicesimo antennomero molto lungo e giallo e la spermateca ricurva per tre volte, sono caratteri che permettono di distinguere la nuova specie da *A. fraterna* Bernhauer, 1920, della Colombia, che è priva di tali caratteri e la spermateca ha maggiore sviluppo e ha introflessione apicale del bulbo distale sottile (e non a forma di grosso granulo come in *fraterna*).

***Atheta (Pseudobessobia) emesakiana* sp. n.**

(Figg. 118–121)

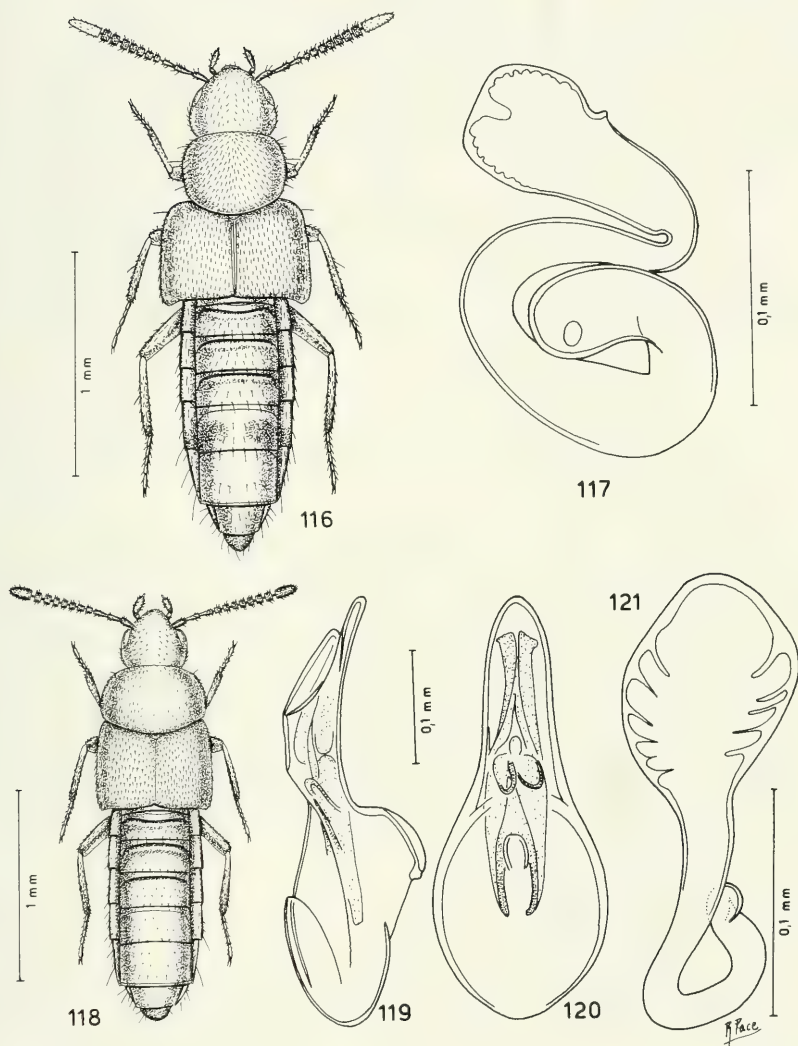
TIPI. Holotypus ♂, Ecuador, Chimborazo, 3600–4800 m, IV.1975, (H. Franz leg., CFR).

Paratipi: 10 es., stessa provenienza.

DESCRIZIONE. Lunghezza 3,3 mm. Corpo lucido e bruno; pronoto bruno-rossiccio; antenne brune con i due antennomeri basali bruno-rossicci; zampe gialle. La reticolazione del capo è svanita, quella del pronoto e dell'addome è assente, quella delle elitre è netta. La punteggiatura del capo è svanita e assente sulla linea mediana, quella del pronoto è superficiale e quella delle elitre svanita. Tubercoli salienti a raspa coprono la superficie dell'addome. Edeago figg. 119–120, spermateca fig. 121.

COMPARAZIONI. Tra le numerose specie del sottogenere *Pseudobessobia* Bernhauer, 1921, che vivono in Sudamerica, l'unica che in base alla forma dell'edeago e della spermateca, appare affine tassonomicamente alla nuova specie è *A. galapagoensis* Pace, 1985, delle Isole Galapagos. I caratteri differenziali sono: occhi lunghi quanto le tempie nella nuova specie e più corti in *galapagoensis*; pronoto bruno-rossiccio nella nuova specie e bruno in *galapagoensis*; pezzi copulatori del sacco interno dell'edeago meno robusti nella nuova specie e più robusti in *galapagoensis*; bulbo distale della spermateca più sviluppato nella nuova specie che in *galapagoensis*.

ETIMOLOGIA. Il nome della nuova specie deriva da 'emesak' che in lingua shuar è l'anima vendicativa che si origina da una persona uccisa che aveva grande forza. Di qui le pratica di tagliare e ridurre la testa dei nemici uccisi per impedire un'azione di rivalsa.



FIGG. 116-121

Habitus, spermatheca ed edeago in visione laterale e ventrale. 116-117: *Atheta (Datomicra) callimaculata* sp. n.: 118-121: *Atheta (Pseudobessobia) emesakiana* sp. n.

***Atheta (Pseudobessobia) arenae* sp. n.**

(Figg. 122–124)

TIPO. Holotypus ♂, Ecuador, Playa Tanga b. Guayaquil, IV.1975, (H. Franz leg., CFR).

DESCRIZIONE. Lunghezza 2,0 mm. Corpo lucidissimo e giallo-rossiccio; metà posteriore delle elitre, e urite libero quarto e base del quinto bruni; antenne brune con i due antenomeri basali e l'undicesimo gialli; zampe gialle. La reticolazione del capo è netta, quella del pronoto è molto svanita, quella delle elitre è superficiale e quella dell'addome è assente. La punteggiatura del capo è distinta. I tubercoli della superficie del pronoto sono molto svaniti, quelli delle elitre sono distinti. Edeago figg. 123–124.

COMPARAZIONI. La nuova specie ha habitus e forma dell'edeago simili a quelli di *A. aspericollis* Bernhauer, 1908, del Paraguay. Tuttavia, sia la taglia corporea che la grandezza dell'edeago sono nettamente minori e dei pezzi copulatori sono raggruppati in un grosso nodulo presso l'orifizio apicale dell'edeago di *aspericollis*: tale struttura è assente nell'edeago della nuova specie.

***Atheta (Pseudobessobia) pululahuensis* sp. n.**

(Figg. 125–126)

TIPO. Holotypus ♀, Ecuador, Vulcano Pululahu, 3000 m, 17.II.1993, (L. Bartolozzi leg., N° 9844, MF).

DESCRIZIONE. Lunghezza 3,2 mm. Corpo debolmente opaco e nero con pronoto e apice dell'addome nero-bruni; antenne nere con antennumero basale e l'undicesimo gialli; zampe gialle. La reticolazione dell'avancorpo è netta, quella dell'addome è composta di maglie trasverse e ondulate distinte. La punteggiatura del capo e del pronoto è estremamente svanita, quella delle elitre è poco distinta. Spermateca fig. 126.

COMPARAZIONI. In base alla forma della spermateca, l'unica specie che è affine alla nuova specie è *A. columbina* Bernhauer, 1920, della Colombia. Ma questa specie ha pronoto poco trasverso e la parte prossimale della spermateca avvolta in una spirale brevissima perché il bulbo prossimale è ben sviluppato, mentre nella nuova specie il pronoto è nettamente trasverso e la parte prossimale della spermateca è avvolta in due ampie spire e manca un distinto bulbo prossimale.

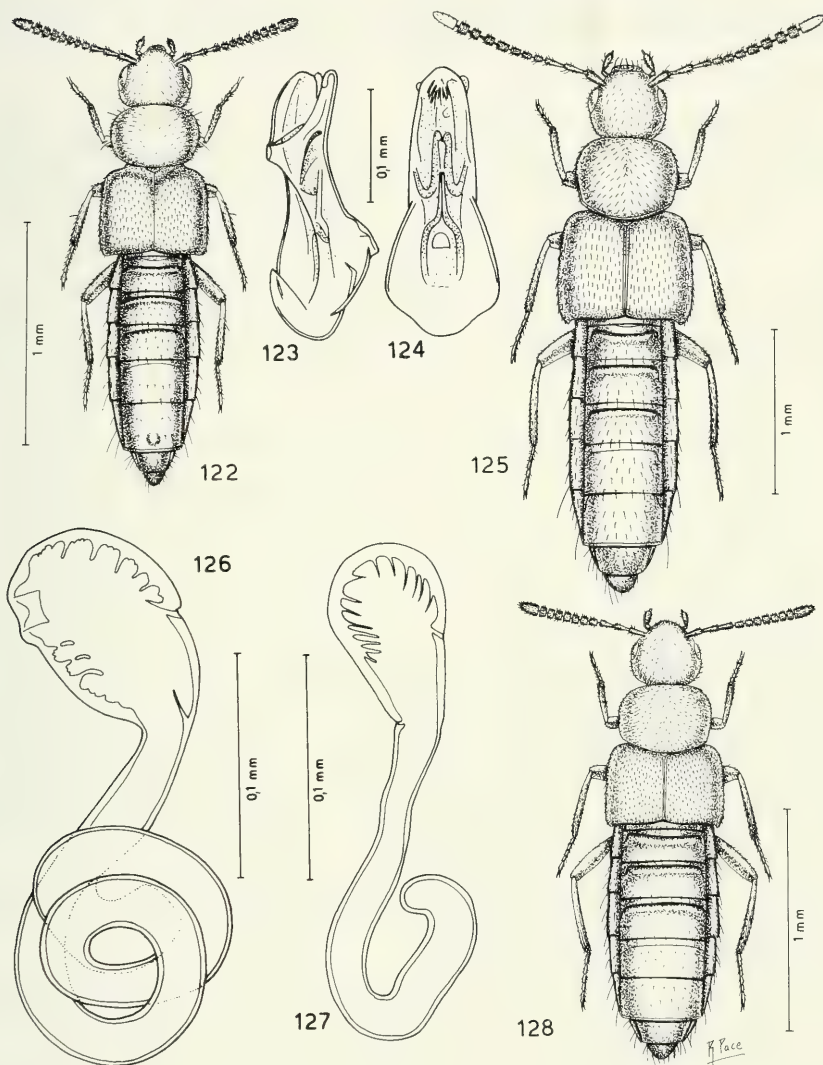
***Atheta (Pseudobessobia) flava* sp. n.**

(Figg. 127–128)

TIPO. Holotypus ♀, Colombia, (MB).

DESCRIZIONE. Lunghezza 1,9 mm. Corpo lucido e giallo-rossiccio; antenne bruno-rossicce con i due antenomeri basali e l'undicesimo giallo-rossicci; zampe gialle. La reticolazione del capo e delle elitre è netta, quella del pronoto è svanita e quella dell'addome è assente. La punteggiatura del capo è fitta, svanita e assente sul disco, quella delle elitre è distinta. Tubercoli fini stanno nel fondo della punteggiatura superficiale del pronoto. Tubercoli finissimi stanno sulla superficie dell'addome. Spermateca fig. 127.

COMPARAZIONI. La spermateca della nuova specie è simile a quella di *A. nigripennis* (Erichson, 1840), delle Antille, ma le elitre della nuova specie sono più corte e sono giallo-rossicce (e non brune come in *nigripennis*); il bulbo distale della spermateca della nuova specie è appena asimmetrico, mentre in *nigripennis* è



FIGG. 122-128

Habitus, edeago in visione laterale e ventrale e spermateca. 122-124: *Atheta (Pseudobessobia) arenae* sp. n.; 125-126: *Atheta (Pseudobessobia) pululahuensis* sp. n.; 127-128: *Atheta (Pseudobessobia) flava* sp. n.

fortemente asimmetrico e a cuspidè; la parte prossimale della spermateca della nuova specie, è corta e largamente ricurva all'apice, mentre in *nigripennis* è lunga e brevemente ricurva all'apice.

RINGRAZIAMENTI

Per il materiale affidatomi in esame, ringrazio molto cordialmente il Dr V. Puthz della "Limnologische Fluss-station" di Schlitz, il Dr L. Bartolozzi del Museo Zoologico de "La Specola" dell'Università di Firenze, Il Prof. Dr H. Franz di Mödling e il Dr M. Uhlig dell'Università Humboldt di Berlin. Per il prestito di tipi ringrazio i direttori e i conservatori dei seguenti Istituti: D.E.I. di Eberswalde, Museo Zoologico dell'Università Humboldt di Berlino, Institut Royal des Sciences Naturelles de Belgique di Bruxelles, il "Naturhistorisches Museum" di Vienna e il British Museum (Natural History) di Londra.

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Some Venezuelan Oligochaeta Glossoscolecidae and Octochaetidae

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Some Venezuelan Oligochaeta Glossoscolecidae and Octochaetidae. -

Four species of earthworms are studied from Venezuela, State of Amazonas, Puerto Ayacucho. The Glossoscolecidae *Rhinodrilus ayacu* n. sp. and *R. cucho* n. sp. are described. The presence of the Octochaetidae *Dichogaster modiglianii* (Rosa) and *D. saliens* (Beddard) is registered.

Key-words: Oligochaeta - Glossoscolecidae - Octochaetidae - Venezuela - Amazonas.

INTRODUCTION

During his ecological studies in Tropical America, Dr Maurizio G. Paoletti (Università degli Studi di Padova, Italy) collected a small number of earthworms and kindly put it at my disposal. I thank to Dr Paoletti for the possibility of this study.

The present collection has two main significances: one of agricultural value and other of zoological value. The agricultural importance is the finding of the pantropical, anthropochoric, African species *Dichogaster modiglianii* and *D. saliens* at 20 cm depth in the soil. In other sites of the Neotropical Region (see below) these species live from 0-10 cm depth; presenting an high populational density and a great digging activity which result in a great number of tortuous galleries. They live mainly in horticultural soils and they recover very well from manual or mechanical agricultural practices (Righi, 1990). Their occurrence at 20 cm depth is another evidence of their usefulness to the cultivable soils in the wet tropics.

The zoological value of this collection is to enlarge our knowledge about *Rhinodrilus*. RIGHI (1985) revised the genus *Rhinodrilus* PERRIER (1872) recognizing 37 species. Later *R. lourdesae* RIGHI (1986) and *R. timote* RIGHI (1989) were added and *R. ayacu* and *R. cucho* are described here. The resulting 41 species of *Rhinodrilus* are distributed in South America between the parallels of 11°N and 28°S, from Trinidad-Tobago to North Argentina. The Venezuelan species are *R. paradoxus*

PERRIER, 1872 (to Federal District and Carabobo and Aragua States), *R. senex* RIGHI, 1984 and *R. timote* RIGHI, 1989 (Aragua State), *R. appuni* (MICHAELSEN, 1892), *R. sieversi* (MICHAELSEN, 1895) and *R. fuenzalidae* CORDERO, 1944 (Carabobo State) and *R. ayacu* n. sp. and *R. cucho* n. sp. (Amazonas State).

MATERIAL AND METHODS

The earthworms were collected in December 1994, in Venezuela, Amazonas State, Puerto Ayacucho (5°40'N–67°05'W) from soil cores at 20 cm depth, in the following localities: Gallery forest; Eisenberg Farm; Mahada. The studies were made by dissections, slides of microscopical pieces mounted in glicerín–water (1 : 1) and serial microscopical sections (10 µm) stained by Mallory's triple method (PANTIN 1964). The sketches were made with camera lucida. The material is deposited in the Departamento de Zoologia, Universidade de São Paulo (ZU) and in the Muséum d'histoire naturelle, Geneva (MHNG).

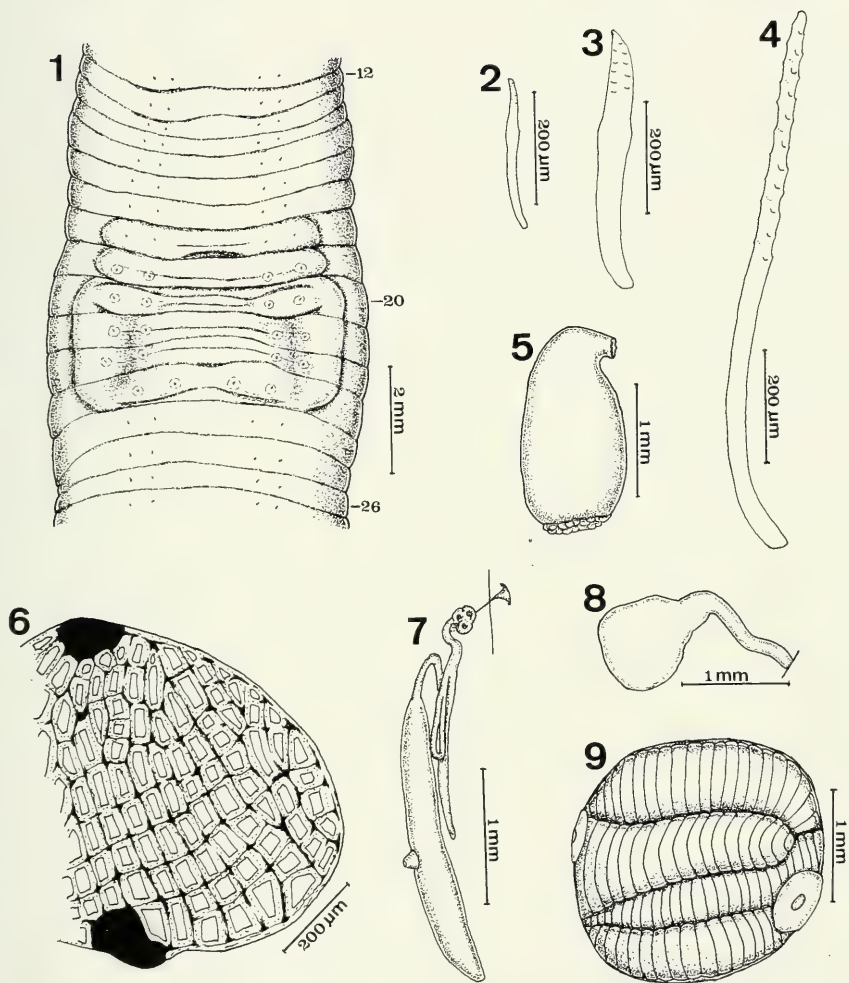
GLOSSOSCOLECIDAE

Rhinodrilus ayacu n. sp.

(Figs 1–9)

Material: Venezuela: Amazonas State: Puerto Ayacucho, gallery forest, 1 clitellate specimen (Holotype, ZU-1283). 1 clitellate and 2 young specimens and 1 cocoon (MHNG 20326 INVE).

Description: Length 80–100 mm. Mid-body diameter 4–5 mm. Number of segments 219–231. Unpigmented. The prostomium and a part of the segment I are invaginated. The segments I–II have a pair of deep nephrobuccal furrows and a lot of shallow longitudinal furrows. The other segments have smooth surface. A constricted “caudal zone”, without setae, occupies 3–4 segments beginning at CXVII–CXXI. The setae are arranged in 4 pairs of regular lengthwise arranged series starting from II. The setal relations are in the mid-body region (LXX–LXXX) $aa : ab : bc : cd : dd = 5.5 : 1.0 : 5.5 : 0.9 : 13.3$ and in the posterior region (CCXX–CCXXX) $= 9.1 : 1.0 : 5.3 : 1.2 : 6.0$; $ab = 400 \mu\text{m}$ in both the regions. The space aa increases from XX–XXII and decreases suddenly at XXIII (Fig. 1). The common setae (Figs. 2–3) are slightly sigmoid with distal nodulus. Their apical 1/6 has 4 alternate rows of semilunar excavations; there are 3–5 excavations per row. Occasionally the excavations are irregularly disposed. The length of the setae varies in the mid-body region: $a.b = 270\text{--}309 \mu\text{m}$ ($M = 288 \mu\text{m}$) and $c.d = 347\text{--}424 \mu\text{m}$ ($M = 384 \mu\text{m}$) and in the posterior region: $a.b = 411\text{--}476 \mu\text{m}$ ($M = 445 \mu\text{m}$) and $c.d = 431\text{--}476 \mu\text{m}$ ($M = 457 \mu\text{m}$). The ventral setae of IX, X–XII and XVIII–XXIII are modified as genital setae, which are straight with a slight proximal bending (Fig. 4). Their distal half has 4 alternate series of excavations. The setae of IX, X–XII and XXIII have 9–10 excavations per series and the setae of XVIII–XXII have 11–13 excavations per series. The length of the genital setae of IX–XII and XXIII varies from 604–848 µm ($M = 735 \mu\text{m}$); the shorter setae are in IX, X. The setae of XVIII–XXII are 874–1054 µm ($M = 993 \mu\text{m}$) long; the shorter ones are in XVIII and the longer ones in XX–XXI.



FIGS 1-9

Rhinodrilus ayacu n. sp.: 1 - Ventral view of the segments XII-XXVI. 2 - Mid-body setae. 3 - Posterior seta. 4 - Genital seta of XIX. 5 - Calciferous gland of IX. 6 - Cross-section of the same. 7 - Mid-body nephridium. 8 - Spermatheca of 6/7. 9 - Cocoon.

The clitellum extends on segments XV–XXV (= 11); it is ring-shaped with a little thickened ventral surface. The ventral surface of IX, X–XII is tumid and more protuberant from front to rear. Voluminous egg-shaped and medially confluent papillae contain the couples of *a*, *b* setae of XVIII, XIX and XXIII (Fig. 1). One pair of similar but does not confluent papillae may occur in XX. Setal papillae contain every *a* and *b* setae of XIX–XXIII. One pair of slightly prominent puberal ridges extends from XX–XXII (= 3 segments) or from 1/2 XX–1/2 XXIII (= 2), laterally to setae *b*. The ridges are associated with clusters of milk-white glandular cells prominent in the body cavity. Three pairs of spermathecal pores are in *cd* line of 6/7–8/9. Female pores not observable. The microscopical male pores open in 20/21 on the puberal ridges. The nephridiopores are intersegmental on *d* line.

The anterior septa resemble long interpenetrated cones. The septa 6/7–9/10 are thick and muscular; the other ones are thin and fragile. The septum 9/10 inserts dorsally in the 10/11 intersegment and ventrally in the 9/10 intersegment; the other septa have regular insertion in their own intersegments. The voluminous globular gizzard lies in VI. Three pairs of calciferous glands have ventral origin in the oesophagus and ascending position in VII–IX. The glands are pear-shaped (Fig. 5) with a wide warty ental appendix. Their structure is typically dichotomous-tubular (Fig. 6) with the small basal (central) cavity restricted to the glandular duct. The intestine begins suddenly at XVIII. There are no intestinal caeca. The typhlosolis begins at XXVII; its twisted anterior margin projects freely up to four segments forwards. In mid-body cross-section the typhlosolis is a dorsal wavy blade as high as the intestinal diameter. Three pairs of thin lateral hearts are in VII–IX and two pairs of bulky intestinal hearts are in X–XI. There is one pair of holonephridia per segment; the nephridia of VI and anterior ones are tangled at the sides of the anterior oesophagus. Each mid-body nephridium (Fig. 7) has a small pre-septal funnel and a post-septal part constituted by two loops connected to the ventral end of the bladder; the loop II extends up to the nephridiopore line and the loop I is half so long. The nephridiopore with strong sphincter is mid-lateral in the bladder.

Each pair of testis sacs coalesces ventrally in X and XI and they grow up surrounding the ventral half of the lateral hearts. There are two pairs of seminal vesicles. The first pair is small and restricted to segment XI; the second pair is band-like and reaches to XVII. Three pairs of spermathecae are in VII–IX; they become bigger from front to rear ($1 < 2 < 3$). On each spermatheca (Fig. 8) the duct is so long as the flattened pear-shaped ampulla; there are not diverticulae and seminal chambers. One pair of milk-white glandular noduli is attached to the inner body wall on the line *ab* of the intersegment 5/6; the noduli are so wide as 1/3 of the first spermathecae.

The cocoon (Fig. 9) is rounded with 4.5 mm in diameter and it contains one well differentiated young. The cocoon wall is translucent light brown; the two thick circular poles without prolongations.

Remarks: *Rhinodrilus ayacu* has affinities to the Colombian *R. sibateensis* (Michaelsen, 1900) due to the position of the clitellum and spermathecal pores on *cd* line of 6/7–8/9 intersegments. The main characteristics to distinguish the two species are: *R. ayacu*: in the posterior body region *aa* = 9 *ab*; *bc* = 4.5 *cd* (*R. sibateensis*: in

the same region $aa = ab$; $bc = cd$); length of the posterior setae 411–476 μm (length up to 800 μm); genital setae ornamented with 9–13 excavations per series (5 excavations per series).

The name of the new species derives from Puerto Ayacucho where it was collected.

Rhinodrilus cucho n. sp.

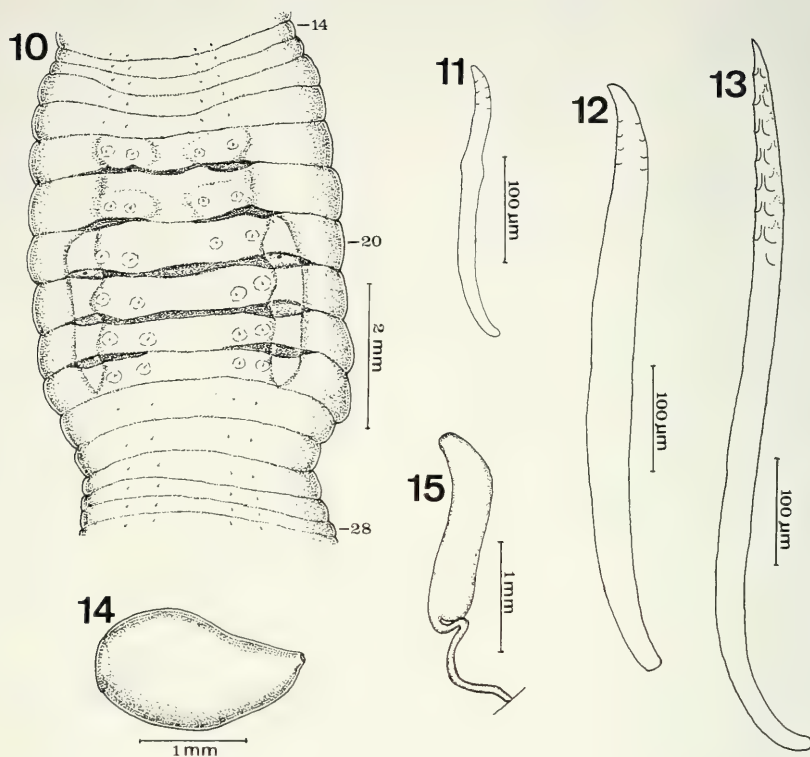
(Figs 10–15)

Material: Venezuela: Amazonas State: Puerto Ayacucho, gallery forest, 1 clitellate specimen (Holotype ZU-1284A), 3 clitellate and 1 mature a clitellate specimens (ZU-1284B; MHNG 20327 INVE).

Description: Length 56–70 mm. Mid-body diameter 3.1–3.5 mm. Number of segments 199–226. The prostomium and a part of the I segment are invaginated. Unpigmented. A constricted ‘caudal zone’ occupies three segments beginning at segment CXXIX–CXXXIV. The setae are four pairs per segment starting from II. The setae *a* and *d* are disposed on regular lengthwise series and the setae *b* and *c* are irregularly disposed in the posterior 1/4–1/5 of the body. The setae *b* lose their regular arrangement from CXXIII–CLIII and the setae *c* from CLXIV–CLXVII. The relations among the setae in the mid-body region (LXX–LXXX) are $aa : ab : bc : cd : dd = 3.0 : 1.0 : 3.4 : 0.6 : 9.0$ ($ab = 400 \mu\text{m}$). The common setae are slightly sigmoid; their distal 1/7 has semilunar excavations irregularly disposed or arranged in 4 alternate series of 3–4 excavations on each one. The setae of the mid-body (Fig. 11) have a distal nodulus and their length varies: the ventral ones from 264–283 μm ($M = 273 \mu\text{m}$) and the lateral ones from 347–399 μm ($M = 376 \mu\text{m}$). The posterior setae (Fig. 12) are much bigger, without nodulus, and there are no significant differences in length among the ventral and lateral ones, which vary from 527–630 μm ($M = 589 \mu\text{m}$). The ventral setae of XVIII–XXIII are modified as genital setae. They are slightly sigmoid with the proximal bending a little bigger than the distal one (Fig. 13). Their distal third presents 4 lengthwise series of excavations. Each two series are disposed side by side and alternately with the other two series; sometimes the 4 series alternate among themselves. The number of excavations per series is 6–9. The genital setae's length varies from 540–726 μm ($M = 608 \mu\text{m}$).

The clitellum extends from XVI–XXVI (= 11 segments); it is ring-shaped opened ventrally by the male genital field in XVIII–XXIII. One pair of a little thick puberal ridges (Fig. 10) lies laterally to the setae *b* from 1/2 XX–1/2 XXIII (= 3 segments) or XX–XXIII (= 4). Two pairs of puberal papillae contain the couples of ventral setae in XVIII and XIX. The ridges and papillae are milk-white. Wide setal papillae contain every ventral setae of XVIII–XXIII. The ventral face of X–XII is tumid. The pair of microscopical male pores is on the puberal ridges in 20/21. The female pores are unrecognisable. Three pairs of spermathecal pores are on line *cd* of 6/7–8/9. The nephridiopores are intersegmental on line *cd*.

The septa 6/7–9/10 are thick and muscular; the other ones are thin and fragile. All septa have regular insertion in their corresponding intersegments. The gizzard is rounded, voluminous and very muscular in VI. Three pairs of calciferous glands depart ventrally from the oesophagus in VII–IX. Each calciferous gland (fig. 14) is



FIGS 10-15

Rhinodrillus cucho n. sp.: 10 - Ventral view of the segments XIV-XXV. 11 - Mid-body seta. 12 - Posterior seta. 13 - Genital seta of XIX. 14 - Calciferous gland of VIII. 15 - Spermatheca of 6/7.

pear-shaped with badly differentiated ental appendix and dichotomous-tubular structure. The origin of the intestine and typhlosolis are not recognizable due to maceration. In cross-section of the mid-body the typhlosolis is a dorsal sigmoid blade as high as the intestinal diameter. There are no intestinal caeca. Three pairs of thin lateral hearts are in VII-IX and two pairs of voluminous intestinal hearts are in X-XI. There is a pair of holonephridia per segment. The nephridia are similar to those of *Rhinodrillus ayacu*, differing by the major length of the loop II.

The testis sacs are perioesophageal in X and XI, surrounding the intestinal hearts and the seminal vesicles of XI. The second pair of seminal vesicles is a little bigger; it attains to segment XIX by piercing the interpenetrated conical septa. Ovaries not observed. The three pairs of spermathecae are in VII-IX; they are similar and become bigger from front to rear ($1 < 2 < 3$). On each spermatheca (Fig. 15) the thin contort duct is as long as the ribbon-shaped ampulla. The transition duct-ampulla

is well demarcated; there are not diverticles or seminal chambers. The ampulla and duct are full of spermatozoa. Two pairs of milk-white pluricellular glands with a thin connective-muscular coat are in VI and IX attached to the inner body wall close to the 6/7 and 9/10 septa, in *ab* line. The glands of VI are rounded, their diameter is half so long as the 6/7 spermathecae. The glands of IX are oblong and three times bigger than those of VI.

Remarks: *Rhinodrilus cucho* is near to the Venezuelan *R. fuenzalidae* Cordero (1944) and *R. corderoi* Righi (1985) due to the remarkable arrangement of the posterior setae and similar position of the spermathecal pores. The characteristics of these species to distinguish them from *R. cucho* are: *R. fuenzalidae* — In the posterior body region the setae *a*, *c* and *d* are on regular lengthwise rows, and setae *b* are on two alternate rows. The posterior setae are not ornamented and they measure up to 1.575 x 0.15 mm. The clitellum is on 1/2 XVI, XVII–XXIV. There are pairs of papillae in VII–IX and XI–XVI. The spermathecae are of similar length; the long spiraled duct is well separated from the discoidal ampulla. *R. corderoi* — In the posterior region the setae *a* are on regular lengthwise rows and the setae *b*, *c* and *d* are irregularly disposed. The clitellum is on XVI, XVII–XXIV. The spermathecae have sack-like ampulla almost two times longer than the corresponding duct.

The name of the new species derives from the name of its type locality.

OCTOCHAETIDAE

Dichogaster modiglianii (Rosa, 1896)

Benhamia modiglianii ROSA, 1896: 510, pl. 1, fig. 1a–b.

Dichogaster modiglianii; RIGHI, 1990: 81, figs 152–154.

Material: Venezuela: Amazonas State: Puerto Ayacucho, Eisenberg Farm, 1 clitellate specimen (MHNG 20328 INVE).

Distribution: Peregrine species; in the Neotropical Region it is known to Mexico, Costa Rica, Panama, Colombia, Peru, Venezuela (Cojedes State: Tinaco; Amazonas State: Puerto Ayacucho), French Guyana and Brasil.

Dichogaster saliens (Beddard, 1892)

Microdrilus saliens BEDDARD, 1892: 683, pl. 46, figs 8, 13.

Dichogaster saliens; RIGHI, 1990: 82, figs 155–158.

Material: Venezuela: Amazonas State: Puerto Ayacucho, Eisenberg Farm, 1 clitellate and 1 acitellate specimens (ZU-1285). Puerto Ayacucho, Mahada, 2 clitellate specimens (MHNG 20329 INVE).

Distribution: Peregrine species, in the Neotropical Region it is known to El Salvador, Costa Rica, Panama, Argentina and Brasil.

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Un nouveau *Apoduvalius* du bassin de la rivière Nalón, Asturias-Espagne (Coleoptera, Trechidae)

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A new *Apoduvalius* from basin of the river Nalón, Asturia-Spain (Coleoptera, Trechidae). - *Apoduvalius espanoli* n. sp. is described and defined specifically on the basis of the shape of the aedeagus and the singular structures of the internal sac. Its taxonomic position is discussed in relation to the species which are morphologically closest to it. In addition, new data are recorded with regard to the fauna of several caves sited in the basin of the Nalón River.

Key-words: Coleoptera - Trechidae - *Apoduvalius espanoli* n. sp. - Spain - Asturia.

INTRODUCTION

De 1989 à 1995, l'auteur visita 23 cavités situées dans les massifs karstiques des Sierra Mermeja, Sierra del Crespón, Sierra Pintacanales, Sierra Giblaniella et du Cordal de Ponga, traversés par la rivière Nalón (Carte).

La faune troglobie découverte dans cette vaste zone calcaire, très diversifiée, est d'un grand intérêt et il faudra s'attendre, dans le futur, à de nouvelles découvertes biopéléologiques. Dans les travaux de JEANNEL (1956, 1958), VIVES (1980) et plus récemment SALGADO (1985, 1988, 1989 a-b, 1991, 1993), plusieurs espèces sont signalées:

- Leptodirinae: *Quaestus pachecoi* (Bolívar, 1915), *Q. recordationis* (Salgado, 1982), *Q. amicalis amicalis* (Salgado, 1984), *Q. luctuosus* (Salgado, 1984), *Q. nietoi* (Salgado, 1988), *Q. longicornis* (Salgado, 1989) et *Notidocharis franzi* Jeannel, 1956;
- Trechidae: *Trechus fulvus* Déjean, 1831, *T. escalerae* Abeille, 1903 et, surtout, *Apoduvalius franzi* Jeannel, 1958, *A. asturiensis* Salgado, 1991 et *A. nalconi* Salgado, 1993;

- Pterostichidae: la donnée la plus significative est *Pterostichus* (*Jeannelinus*) *drescoi* (Nègre, 1957);
- Staphylinidae: *Cantabrodytes vivesi* Español, 1975, espèce très intéressante.

Dans cette liste, il faut relever la capture récente, dans la grotte de Refidieyu "B", Muñera, de deux espèces de *Apoduvalius*, *A. naloni* et *A. asturiensis*, seule donnée qui montre jusqu'à présent la coexistence de deux espèces du genre *Apoduvalius*.



Carte: Coordonnées et carte de distribution de quelques *Apoduvalius*. 1: Grotte Les Canales (UTM : 30TUN112828), *A. espanoli* n. sp.; 2: Grotte de Refidieyu "B" (UTM : 30TTN 949909), *A. asturiensis* et *A. naloni*; 3: Grotte du Sierru (UTM : 30TTN899873), *A. asturiensis*; 4: Refuge de Vega Redonda (UTM : 30TUN388887), *A. lecoqi*; 5: Grotte de Porro Covaña (UTM : 30TUN405889), *A. negrei*.

La grotte de Les Canales est située dans une zone de "Calizas de Montaña" du Carbonifère et d'accès est très facile. L'entrée est très étroite et l'ouverture orientée vers le SE, sur la rive droite de la rivière Nalón et près de son lit. La partie connue présente environ 800 m de développement, avec de grandes salles, des galeries étroites et vers la moitié, sur sa gauche, un puits de presque 30 m. Dans cette grotte sinueuse, on peut observer de grandes coulées et de belles concrétions, aujourd'hui en partie détruites. La grotte de Les Canales se trouve à 18 km de la grotte la plus proche abritant *Apoduvalius*, la Grotte de Refidieyu "B", Muñera et à 590 m d'altitude.

Du point de vue géographique *Apoduvalius espanoli* n. sp. est nettement isolée par les bassins des rivières Sella et Ponga (voir carte), de l'espèce morphologiquement la plus proche, *A. lecoqi*. D'un autre côté, *A. lecoqi* a été découverte à plus de 30 km de *A. espanoli* et à 1800 m d'altitude en bordure de névé. Il est intéressant de remarquer que, contrairement à toutes les autres *Apoduvalius*, *A. lecoqi* n'est pas cavernicole, du moins dans sa localité d'origine.

Dans la grotte de Les Canales, *Apoduvalius espanoli* n. sp. cohabite avec deux espèces de Leptodirinae, *Quaestus amicalis amicalis* et *Q. recordationis*, et avec deux autres Pterostichinae, *Anthisphodrus pelaeus* (fréquent et commun) et *Pterostichus (Jeannelinus) drescoi* (très rare), raison pour laquelle la donnée de distribution de cette dernière espèce est très intéressante.

***Apoduvalius (Apoduvalius) espanoli* n. sp.**

Diagnose. *Apoduvalius* du sous-genre s. str., sans pubescence élytrale, d'une taille comprise entre 3,60 et 3,75 mm, se définit par le pronotum plus large que long, avec les fossettes basales profondes et les angles postérieurs très aigus; par les stries élytrales visibles, mais un peu effacées et, surtout, par la forme générale de l'édéage, en particulier la structure des pièces copulatrices du sac interne, la forme du bulbe basal et de l'aileron sagittal.

Série typique: Holotype ♂, Grotte de Les Canales, 17-X-1992, Beneros (Asturies), leg. Salgado (coll. Muséum d'histoire naturelle de Genève). Paratypes: 2 ♂ et 3 ♀, mêmes données; 1 ♂, même grotte, 2-VI-86, leg. Salgado (coll. Muséum d'histoire naturelle de Genève; coll. Muséum d'Histoire Naturelle de Paris, et coll. Salgado).

Description de l'holotype (pour toutes les mesures, 50 unités = 1 mm): Longueur: 3,70 mm (de l'apex du labre jusqu'à l'apex des élytres; longueur des paratypes, 3,63–3,72 mm); coloration uniformément marron-rougeâtre brillante.

Tête assez robuste, plus longue que large (rapport longueur/largeur: $45/36 = 1,25$) et légèrement plus étroite que la largeur maximale du prothorax. Anophtalme, mais avec la cicatrice oculaire bien différenciée, blanchâtre, linéaire et oblique. Mandibules relativement longues et robustes. Tempes assez amples et convexes, glabres. Sillons frontaux complets, régulièrement arqués et assez profonds au niveau des yeux. Clypéus très transverse, trois fois plus large que long. Antennes d'une longueur moyenne, presque de la même longueur que les élytres (longueur élytres/longueur antennes: $100/96 = 1,04$), et où les quatre derniers articles dépassent le bord postérieur du pronotum.

Pronotum légèrement transverse (rapport largeur/longueur: $39/33 = 1,18$), très cordiforme, avec la largeur maximale vers le quart antérieur; les côtés nettement sinués avant les angles postérieurs, très aigus et un peu courbés vers la pointe. Base rectiligne, nettement plus étroite que la marge antérieure. Disque convexe, avec ligne médiane complète et bien différenciée. Fossettes basales petites, mais assez profondes (fig. 1).

Elytres allongés, elliptiques (rapport longueur/largeur: $100/62 = 1,61$), un peu convexes et nettement réduits dans la région antérieure, avec la plus grande largeur vers le tiers postérieur, beaucoup plus larges que le pronotum (largeur élytres/largeur

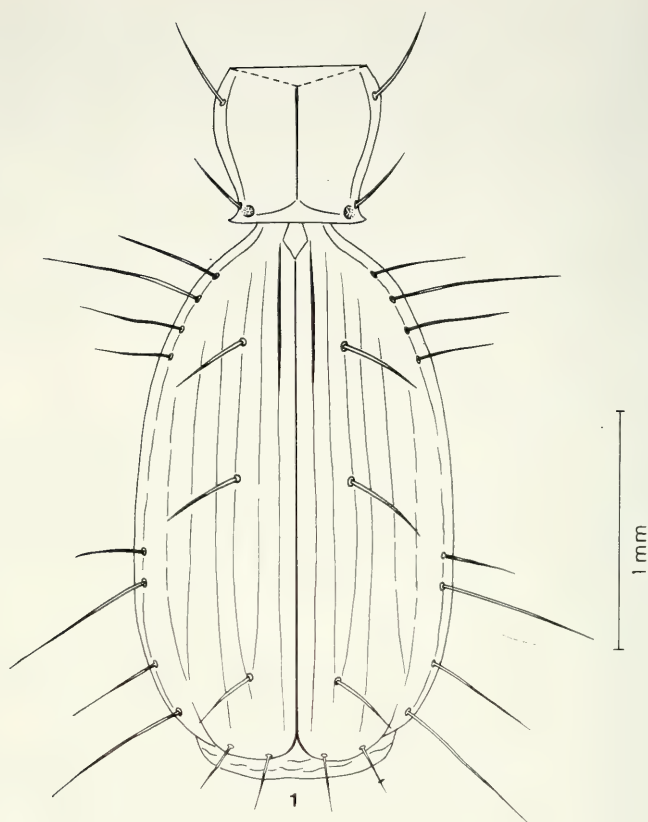


FIG. 1

Apoduvalius espanoli n. sp., silhouette du pronotum et élytres.

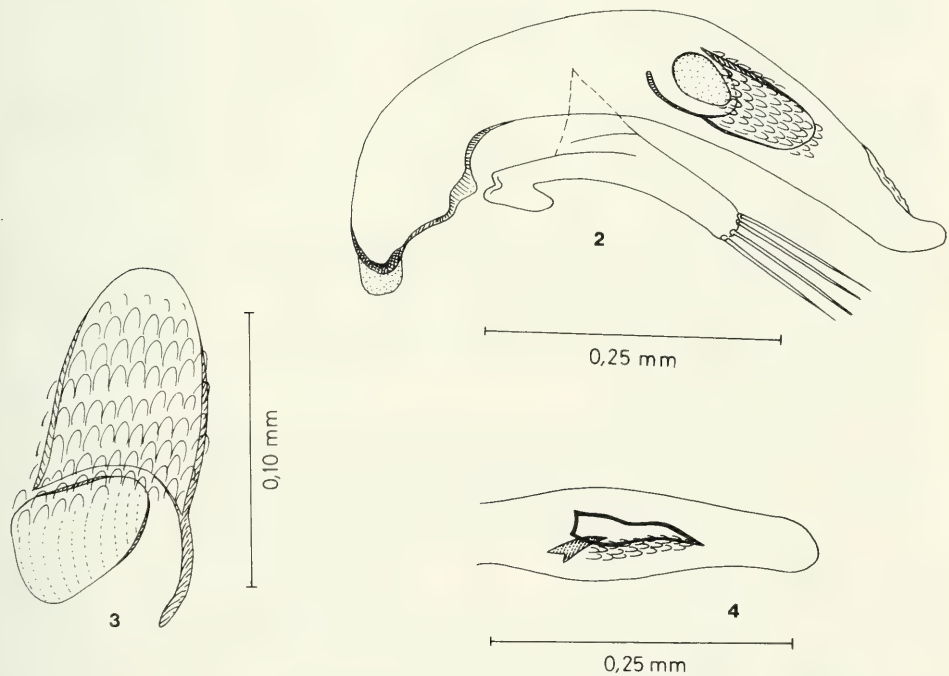
pronotum: $62/39 = 1,59$); angles huméraux peu accentués, rebord marginal régulier. Toutes les stries élytrales, légèrement accentuées, sont bien visibles, principalement dans la zone médiane, les externes étant plus effacées que les internes, et les interstries un peu convexes.

Chétotaxie: deux soies frontales; deux pronotales, l'une antérieure, située au point où la largeur du pronotum est la plus grande, l'autre postérieure, devant l'angle postérieur et insérée dans le même bord. Trois soies discales sur la troisième strie; la première discale au quart antérieur de l'élytre, la deuxième à la moitié et la troisième à l'union entre la deuxième et la troisième strie, cette dernière étant plus éloignée de l'apex élytral que de la suture. Dans la série ombiliquée ajoutée, les quatre humérales antérieures sont presque équidistantes, étant donné que les troisième et quatrième fossettes sont un peu plus éloignées, celles du milieu insérées vers le tiers élytral, et les deux postérieures dans le cinquième apical (fig. 1).

Edéage allongé, un quart de la longueur du corps, et en douce courbure dorsal (fig.2). Lobe moyen avec le bulbe basal un peu réduit postérieurement et pourvu d'un aileron sagittal court et étroit; zone apicale courte, un peu élargie et faiblement soulevée. Deux pièces copulatrices superposées, asymétriques, et en position latérale sur le sac interne, l'une petite, ayant une forme apparemment ovale; l'autre, plus grande, allongée et avec une forme cannelée, irrégulière et plus large au bord postérieur, arrondie et un peu plus étroite à l'extrémité antérieure; les deux pièces sont couvertes par de petites écailles (fig. 3). Les styles ont quatre soies et l'apophyse proximale du style gauche est bien visible et arrondie.

En vue dorsale, la forme des deux pièces copulatrices du sac interne est nettement différente (voir fig. 4).

Etymologie: Cette nouvelle espèce est dédiée au Professeur F. Español, principal promoteur de la biospéléologie en Espagne.



FIGS 2-4

Apoduvalius espanoli n. sp (holotype): (2) édéage, vue latérale; (3) pièces copulatrices, vue latérale; (4) lobe médian, vue dorsale.

Discussion: La nouvelle espèce, par sa répartition, est proche géographiquement de *Apoduvalius nalonii* et *A. asturiensis*, mais s'en différencie nettement aussi bien par la morphologie externe que par la forme des génitalia.

Par ses caractères morphologiques, *Apoduvalius espanoli* n. sp., se rapproche de *Apoduvalius negrei* de la Grotte de Porro Covañona, à Covadonga (JEANNEL, 1953); de *A. serrae* de la Grotte de Balmori, à Llanes (VIVES, 1975); de *A. lecoqi*, la seule espèce nivicole qui se trouve aux Pics d'Europe, à 1.800m d'altitude, une zone proche de Covadonga (DEUVE, 1991). Elle se distingue cependant de *A. negrei* par une taille un peu plus grande, les angles postérieurs du pronotum plus aigus et plus vifs, et les stries élytrales moins visibles. Quant à l'édéage, les différences peuvent être observées dans la zone apicale qui est plus grosse, le bulbe basal plus étroit et l'aileron sagittal plus réduit chez *A. espanoli* n. sp., tandis que l'endophallus renferme deux pièces copulatrices, au contraire d'*A. negrei* qui n'en possède qu'une petite. Par rapport à *A. serrae*, les différences de la nouvelle espèce sont les suivantes: une tête un peu plus grosse, un pronotum un peu plus long et des angles postérieurs un peu courbés; stries des élytres plus marquées, zone apicale de l'édéage moins pointue, bulbe basal plus large et présence de deux pièces copulatrices dans le sac interne (une seulement pour *A. serrae*). Finalement, *A. espanoli* diffère de *A. lecoqi* par une taille un peu plus grande, une tête moins grosse, un pronotum plus court et des stries élytrales plus effacées; par rapport à l'édéage, la zone apicale est plus courte et grosse, le bulbe basal plus large et l'aileron sagittal plus réduit, en plus des pièces copulatrices bien distinctes, et l'apophyse proximale du style gauche plus développée.

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***Spinolyprops pakistanicus* sp. n. (Coleoptera: Tenebrionidae),
an Oriental element in the fauna of northern Pakistan**

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***Spinolyprops pakistanicus* sp. n. (Coleoptera: Tenebrionidae), an Oriental element in the fauna of northern Pakistan.** – *Spinolyprops pakistanicus* sp. n. from Hazara and Swat in northern Pakistan is described, having a sexually dimorphic tibia, a structure yet unknown among the other congeners. In the fauna of northern Pakistan, generally containing mainly Palaearctic elements, the genus *Spinolyprops* is a further example with distinct Oriental distributional pattern.

Key-words: Coleoptera - Tenebrionidae - *Spinolyprops* - New species - Pakistan - Zoogeography.

INTRODUCTION

The genus *Spinolyprops* Pic, 1917 was based on an African species and was later recorded also from the Oriental region (KULZER 1954, KASZAB 1965). The genus contains five uniform species which can be separated easily by the specific shape of the aedeagus. A further species is added here originating from Hazara and Swat in northern Pakistan. *Spinolyprops pakistanicus* sp. n. is remarkable for its geographical origin (Fig. 6) and its sexually dimorphic tibia, a feature yet unknown in this genus.

MATERIAL

HNHM Hungarian Natural History Museum Budapest

MHNG Muséum d'Histoire Naturelle Genève

SMNS Staatliches Museum für Naturkunde in Stuttgart

THE ORIENTAL SPECIES OF *Spinolyprops*

***Spinolyprops himalayicus* Kaszab, 1965**

Material: India, Uttar Pradesh, Mussorie, 1300 m, 10.VII.1989 leg. A. Riedel, 1 ex. SMNS. Nepal, Gorkha Distr., Arughat Bazar, 600 m, 26.VII.1983 leg. J. Martens & W. Schawaller, 1 ex. SMNS. Thailand, Changwat Chiang Mai, Doi Pui, 1500 m, 19.XII.1988 leg. K. Geigenmüller & J. Trautner, 1 ex. SMNS. Thailand, Amphoe Chiang Dao, Doi Chiang Dao,

* Contribution to Tenebrionidae, no. 15. For no. 14 see: *Acta Zoologica Academiae Scientiarum Hungaricae* 41: 327-334, 1995.

Manuscript accepted 14.11.1995.

1700 m, 9.I.1989 leg. K. Geigenmüller & J. Trautner, 1 ex. SMNS. Thailand, Soppong, 19.29 N/98.18 E, 750 m, 13.V.1993 leg. L. Bocák, 1 ex. SMNS. Vietnam, Prov. Daklak, Buon Ma Thuot, Dak Linn, 500 m, 28.–29.IV.1986 leg. S. Golovatch & L. Medvedev, 7 ex. SMNS.

Distribution: Northern India, Nepal, Thailand, Vietnam, West-Bengal: Peshok (type locality).

***Spinolyprops lateralis* Pic, 1917**

Material: Not seen.

Remarks: This taxon was described as a variety of the African *S. rufithorax* Pic, 1917. It seems doubtful that the African and Sumatran populations are conspecific. New material from Sumatra was unknown to KASZAB (1965) and to the present author (collections HNHM, MHNG, SMNS). It can not be excluded, that the following species *maculatus* from Sri Lanka and southern Burma is conspecific.

Distribution: Sumatra.

***Spinolyprops maculatus* Kulzer, 1954**

Material: Sri Lanka, Uva, Diyaluma Falls, 400 m, 23.I.1970 leg. C. Besuchet, I. Löbl & R. Mussard, 3 ex. MHNG, 1 ex. SMNS. Sri Lanka, Kandy, at light, 18.III.1973 leg. G. Zimmermann, 1 ex. SMNS.

Distribution: Sri Lanka (type locality) (KULZER 1954), S Burma: Tenasserim (KASZAB 1965).

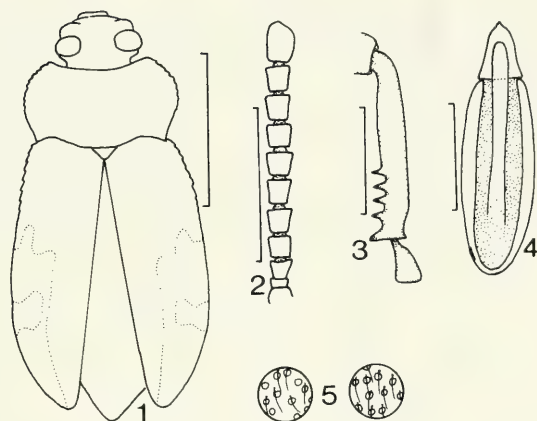
***Spinolyprops pakistanicus* sp. n.**

(Figs 1–5)

Holotype (♂): Pakistan, Hazara, Malkandi, 1500 m, 3.VI.1983 leg. C. Besuchet & I. Löbl, MHNG.

Paratypes: Same data as holotype, 4 ex. MHNG, 2 ex. SMNS; Hazara, Kaghan Valley, Malkandi, 1400 m, 19.–20.IV.1984 leg. S. Vit, 1 ex. MHNG; Hazara, Shogran, 2400 m, 3.VI.1983 leg. C. Besuchet & I. Löbl, 1 ex. MHNG; Swat, Madyan, 1400 m, 16.V.1983 leg. C. Besuchet & I. Löbl, 3 ex. MHNG, 1 ex. SMNS.

Description: Body length 4.5–5.0 mm. Head with about 25 coarse punctures irregularly distributed on the vertex between the eyes. Clypeus separated from the vertex by a distinct transverse impression between the antennal insertions. Proportions of the antennal segments as in Fig. 2. Eyes with large facets, the eye diameter consists of about 6 facets. Shape of the pronotum as usual in the genus with acute posterior corners (Fig. 1), lateral margin serrate in the anterior half. Pronotum coarsely punctured, punctures sparser distributed on the disc but without distinct unpunctured fields. Setae on pronotum about 3–4 times as long as diameter of the punctures (Fig. 5). Elytra including epipleura with about the same punctation as on the lateral sides of the pronotum, setae about 3–4 times as long as diameter of the punctures (Fig. 5). Lateral margin serrate in the anterior third. Each elytron with 2 confluent light spots on the posterior half, pattern as in Fig. 1. Metasternum laterally with coarse punctures like those on the elytra, medially without punctation. Punctures on the abdominal sternites half the diameter of the elytral punctures, last sternite not with coarser punctures. Legs with striking sexual dimorphism: mesotibia in males on the inner side with about 5 distinct spines (Fig. 3), unarmed in females. Wings present. Aedeagus as in Figs 4–5.



FIGS 1–5

Spinolyprops pakistanicus sp. n. holotype ♂. – 1: Dorsal view, scale 2 mm; 2: Antenna, scale 1 mm; 3: right mesotibia, scale 0.5 mm; 4: Aedeagus, scale 0.5 mm; 5: Punctuation and setation on medial part of pronotum (left) and on disc of elytra (right).

Remarks: *Spinolyprops pakistanicus* sp. n. is the first known species of the genus having sexual dimorphic legs. The other species show no differences in tibial morphology between males and females. In addition, the aedeagus has a specific shape, in particular the shape of the fused parameres with an acute tip (see parameres of the other Oriental species in Fig. 6). Apart from these distinct characters, the punctuation and setation on pronotum and elytra is specific but difficult to use without having the other species at hand. The dorsal punctuation is finer and similar to that in *maculatus*, but coarser in *himalayicus* and in particular in *trautneri*. The dorsal setation is similar to that in *maculatus* and *himalayicus*, but distinctly shorter in *trautneri*. The body shape and proportions and the colour pattern of the elytra are of less taxonomic value.

Distribution: Pakistan (Hazara, Swat).

***Spinolyprops trautneri* Schawaller, 1994**

Material: Philippines, Leyte, Lake Danao, 500 m, 19.II.–18.III.1991 leg. K. Geigenmüller, W. Schawaller & J. Trautner, holotype ♂ SMNS.

Distribution: Known only from the Philippine Island Leyte (SCHAWALLER 1994).

ZOOGEOGRAPHY

The mountain ranges of the Himalayas lodge an extremely species-rich fauna, not only of Coleoptera. A first simple reason for this 'megadiversity' is the position of the Himalayas at the junction of 2 faunal regions, the Oriental region in the south and the Palaearctic region in the north. Taxa penetrate from both regions into the Himalayas thus increasing species numbers. Furthermore, a number of taxa reaches the Himalayas from the mountains of the deep meridional upstreams of the rivers Irawady, Salween, Mekong, Yangtse and Yalung (Himalayan subregion sensu MARTENS 1979), being itself a mixture of Palaearctic and Oriental elements with many relic endemites. Additionally, the high vertical zonation with different climatical belts allows a coexistence of many closely related immigrants and the diverse isolations by deep valleys and high mountain ranges promotes the evolution of new species swarms from single ancient immigrants in particular of those with reduced migration possibilities.

In general, the faunal diversity in the Himalayas increases from west to the east. It is known for a long time that the very western parts in northern Pakistan and Kashmir generally have a quite poorer (concerning species number) fauna than the eastern Himalayas in Nepal, Sikkim, Darjeeling and the nearly unexplored northeastern Assam. The fauna in the western Himalayas is hitherto considered to be closely related to the faunas in the Middle Asian mountains (Pamir, Tien-Shan) and to the Afghanistan fauna, thus containing mainly Palaearctic elements. The abundant occurrence of the tenebrionid genera *Platynoscelis* (sensu lato), *Prosodes* or of the silphid genus *Aclypea* may be mentioned here as examples for palaearctic taxa on the genus level, lacking in the central and eastern Himalayas.

However, already LÖBL (1986) recognized a number of taxa from the Coleoptera families Pselaphidae and Scaphidiidae (subfamilies of Staphylinidae sensu LAWRENCE & NEWTON 1995) in northern Pakistan at least in Hazara and Swat having an Oriental origin. The family Discolomatidae, restricted to tropical habitats, also occurs in Hazara and Swat (SCHAWALLER 1989). The tenebrionid genus *Spinolypros* seems to be a further example for this distinct Oriental distributional pattern. Its species are recorded (apart from eastern Africa) from southeastern continental Asia, the Philippines, Sri Lanka and Sumatra (Fig. 6). In Nepal, *himalayicus* is known only from low altitudes below 1000 m with subtropical vegetation. Thus the occurrence of *Spinolypros pakistanicus* sp. n. in Hazara and Swat but not in Chitral up to 2400 m is remarkable. Obviously, some taxa with a generally Oriental origin can penetrate also in the very western Himalayas through the valleys of the river Indus and its tributaries. This holds true in particular for mobile taxa like *Spinolypros* (with functional hind wings).

It is not clear up to now if the occurrence of species in eastern Africa and southeastern Asia including the Philippines point to an ancient Gondwana origin before the separation of the continental plates or if the single African species has been introduced secondarily from tropical Asia.

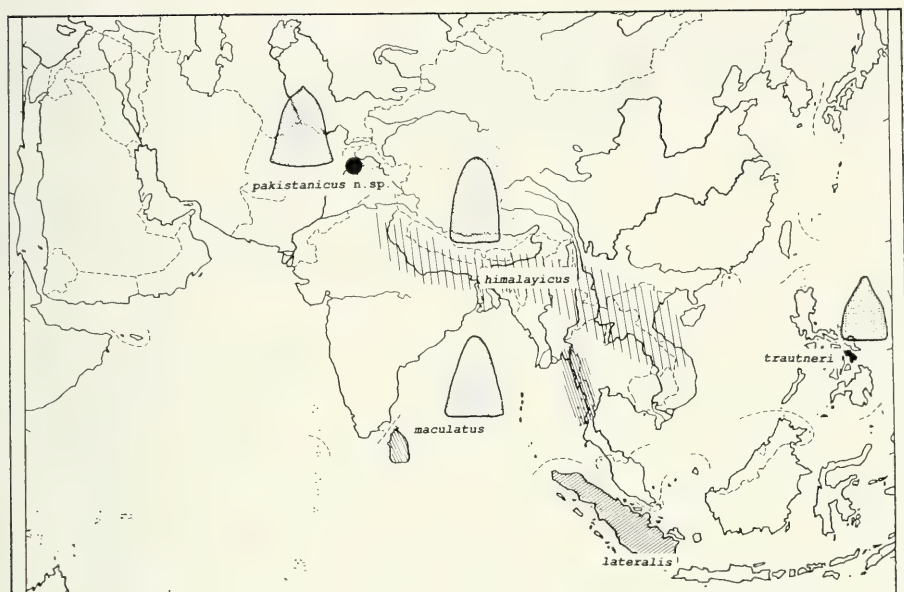


FIG. 6

Distribution of the Oriental species of *Spinolyprops* and shape of the parameres (aedeagus of *lateralis* unknown).

ACKNOWLEDGMENTS

For the loan of material I thank Dr Ivan Löbl (Genève) and Dr Otto Merkl (Budapest).

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***Agauopsis* (Acari, Halacaridae) of the Sevastopol area; supplementary notes on taxonomy and ecology**

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***Agauopsis* (Acari, Halacaridae) of the Sevastopol area; supplementary notes on taxonomy and ecology.** - Females, males and juveniles of *Agauopsis marinovi* Petrova, and the two closely related species *A. brevipalpus* (Trouessart) and *A. ibssi* sp. n. are described. *A. marinovi* is found in large numbers in deep layers of beaches with very coarse, unsorted sediment. *A. ibssi*, which is also psammophilous, is the dominating halacarid species in coarse subtidal sand. *A. brevipalpus* is an inhabitant of bushy, green, brown and red algae.

Key-words: Black Sea - Halacarid mites - *Agauopsis* - Descriptions.

INTRODUCTION

A first survey on halacarid mites of the Black Sea was published by CHICKOFF (1907), and the first halacarid mites from the Sevastopol area were recorded by VIETS (1928). CHICKOFF (1907) reported on twelve mites, collected in various depths along the coast of Bulgaria, and VIETS (1928) added four more species to the Black Sea fauna and presented descriptions of seven halacarid mites. In the following decades, new species, new records and supplementary data on biology and ecology of Black Sea halacarids were presented by MOTAS & SOAREC (1940), CASPERS (1951), MARINOV (1964), MAKKAVEEVA (1961, 1966a, b), BACESCU *et al.* (1963, 1967), KONNERTH-IONESCU (1968, 1970, 1971, 1972, 1973, 1979), PETROVA (1972a, b, 1976) and VOROBIEVA & YAROSHENKO (1982).

MATERIAL AND METHODS

Sandy deposits, algae and colonies of mussels and their epibionts were collected in May 1995 in the Sevastopol area, in the upper littoral zone by hand, in deeper water with a dredge. The halacarid mites were extracted by washing with fresh water through a 100 µm sieve. The meiofauna retained in the sieve was sorted under a binocular microscope. The mites were cleared in lactic acid and mounted in glycerine jelly.

Slides with type and voucher specimens are deposited in the Muséum d'histoire naturelle, Genève (MHNG), Naturhistorisches Museum Basel (NMB), Zoologisches Institut und Zoologisches Museum, Hamburg (ZIMH), and the author's collection.

Abbreviations used in the descriptions: AD, anterior dorsal plate; AE, anterior epimeral plate; ds, dorsal setae on idiosoma, ds-1, first pair of dorsal setae; GA, genitoanal plate; GO, genital opening; OC, ocular plate(s); P, palp, P-2, second palpal segment; pas, parambulacral setae; PD, posterior dorsal plate; PE, posterior epimeral plate; pgs, perigenital setae; sgs, subgenital setae; vl, ventrolateral; vm, ventromedial. Legs numbered I to IV, leg segments 1 to 6, i.e. trochanter, basifemur, telofemur, genu, tibia, and tarsus.

RESULTS

Three species of the genus *Agauopsis* were found in the Sevastopol area. The crevice system between bushy algae was inhabited by *A. brevipalpus*; sublittoral sandy deposits contained large numbers of *A. ibssi*, and deep layers of beaches harboured *A. marinovi*.

Agauopsis brevipalpus (Trouessart, 1889)

Figs 1-11

Agaua brevipalpus TROUESSART, 1889a: 1180, 1181; TROUESSART, 1889b: 181; TROUESSART & NEUMANN, 1901: 253, pl. 5, figs 2, 2a-2c.

not *Agaua brevipalpus*, LOHMANN, 1893: 22, 87; RAO & GANAPATI, 1968: (117).

not *Agauopsis brevipalpus brevipalpus*, NEWELL, 1947: 186-189, fig. 316.

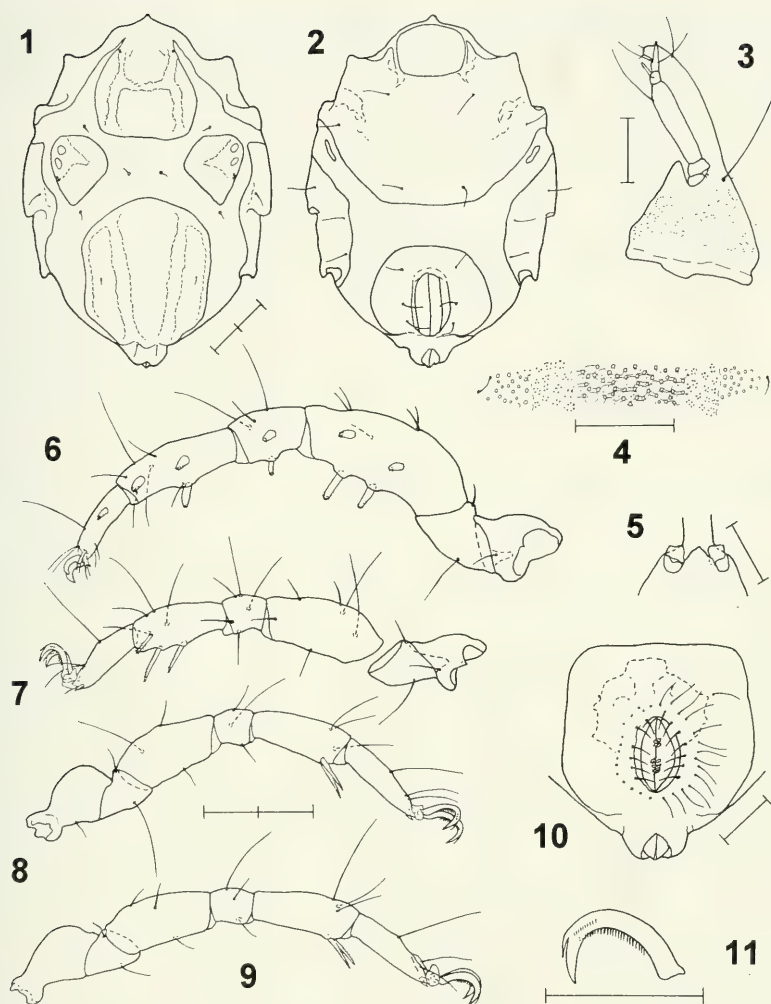
Agaua brevipalpus var. *pontica* CHICHKOFF, 1907: 258-259, plate 21, figs 1-7 (syn. n.).

Material Examined: One ♂, Crimea, Sevastopol, south-east coast, 2-4 cm high thickets with *Corallina* sp. (red algae), 0.3-0.5 m below water level, 11 May 1995 (MHNG). One ♀, 1 protonymph, same locality, 17 May 1995 (MHNG). One ♀, same locality, 17 May 1995 (NMB). One ♀, 1 ♂, same locality, 11 May 1995 (ZIMH A63/95). Four ♀, 2 ♂, 1 deutonymph, 2 protonymphs, same locality, 11 and 17 May 1995, and 2 ♀, 2 ♂, 1 deutonymph, 1 protonymph, same locality but from *Enteromorpha* and *Cladophora* spp. (green algae) and other small algae from rock pool, 2 and 11 May 1995 (author's collection). One ♀, 1 ♂, 1 deutonymph, 1 protonymph, mole of Sevastopol harbour, *Mytilus* sp. and algae from concrete tetrapods, 1-1.5 m depth, 3 May 1995; 3 ♀, 1 ♂ (author's collection), Omega Bay, *Cystoseira* sp. (brown algae) and other algae from pier, 0-2 m depth, 6 May 1995; 3 ♀, 1 ♂, 2 deutonymphs, 2 protonymphs (author's collection), Kazachya Bay, *Cladophora* sp. (green algae) and sediment, 10 m depth, 12 May 1995 (all in the author's collection).

Four ♀, 1 deutonymph, Crimea, Laspi, small thickets of *Corallina* sp., 10-15 cm below water level, 21 May 1995 (author's collection).

Holotype ♀, France, Atlantic coast, Le Croisic, from red algae (Muséum National d'Histoire Naturelle, Paris, Collection E. Trouessart Nr. 18C9).

Description (Black Sea material): ♀ - Length of idiosoma 470-542 µm. Integument of plates brownish; eye spots present beneath AD and OC. Raised porose areolae of dorsal plates with canaliculi of rosette pores piercing the integument; ostia lacking (Fig. 4). Remainder of plate with scattered delicate canaliculi, and surface of plate panelled due to cuticular droplets which are more or less fused, thus forming a reticulum. AD (Fig. 1) with small frontal process; posterior margin truncate or somewhat excavated. Plate with distinctly raised H-like costa; rosette pores reduced



FIGS 1-11

Agauopsis brevipalpus (Trouessart), 1, idiosoma, dorsum, ♀; 2, idiosoma, venter, ♀; 3, gnathosoma, lateral, ♀; 4, portion of PD between ds-5, ♀; 5, tectum, dorsal, ♂; 6, leg I, medial, ♀; 7, leg II, medial, ♀; 8, leg III, medial, ♀; 9, leg IV, medial, ♀; 10, genitoanal plate, ♂; 11, claw of tarsus III, ♂. (Each scale division = 50 µm)

to three to five canaliculi. Pair of gland pores level with insertion of leg I. OC with rounded angles. Plate with two corneae; porose areola triangular in outline. Lateral margin with gland pore and pore canaliculus. Anterior margin of PD rounded. Plate with pair of medial and lateral costae; costae of either side fused anteriorly. Medial costae four pycnic rosette pores wide, each rosette pore with three to five canaliculi.

Dorsal setae 10 μm long and rather stout, ds-1 inserted on AD slightly posterior level with pair of gland pores, setae ds-2, ds-3 and ds-4 within striated integument, anterior, between and posterior to OC respectively; ds-5 on PD within reticulate area between medial and lateral costae and on level with insertion of leg IV.

Ventral plates porose and faintly reticulate. AE (Fig. 2) wide; opening of epimeral pore slit-like; internal sacculus 10 μm long. Posterior margin of AE and anterior margin of GA truncate. GO large, distance from anterior margin of genital foramen to margin of GA 0.3 times length of foramen.

Gnathosoma slender, 1.9 longer than wide. Integument of gnathosomal base pierced by numerous canaliculi (Fig. 3). Rostrum about as long as gnathosomal base. Tectum (Fig. 5) triangular, extending to end of P-1. One pair of maxillary setae on gnathosomal base, one pair near apex of rostrum. Palps slender. P-2 4.0-4.4 times longer than high; with one dorsal seta. P-3 short, with dorsomedial bluntly ending, pectinate spine. P-4 somewhat longer than P-3, with two basal setae.

Integument of telofemora reticulate and with canaliculi. Telofemora I - IV 2.5, 2.2, 2.2 and 2.3 times longer than high, and 1.5, 1.3, 1.1 and 1.1 times longer than tibiae I - IV. Chaetotaxy of legs, from trochanter to tibia (setae in arabic and spines in roman numerals): leg I, 1, 2, 5+IV, 3+II, 6+III; leg II, 1, 2, 6, 5, 7; leg III, 1, 2, 3, 3, 5; leg IV, 0, 2, 3, 3, 5. Spines of leg I short, apically blunt and pectinate. I-3 (Fig. 6) with two ventral spines, basal one 26 μm , distal one 31 μm long; ventromedial spines both 25 μm long; I-4 with 17 μm long ventral and almost 25 μm long ventromedial spine; I-5 with one ventral and two ventromedial spines, each 25 μm long; tarsus I with 16 μm long ventromedial spine. Tibia II (Fig. 7) with three spine-like, bipectinate bristles; these bristles about as long as height of tibia II. Tibiae III (Fig. 8) and IV (Fig. 9) each with pair of spine-like pectinate bristles. Tip of tarsus I with pair of doubled pas, tip of tarsus II medially with spine-like, laterally with a long and a short seta-like pas, tarsi III and IV each with a single spine-like pas in lateral position.

Pair of claws on tarsus I smooth, distinctly shorter than those of succeeding legs; median claw stout, bidentate. Paired claws of tarsi II - IV long, with accessory process and pecten (Fig. 11). Numerous tines of pecten arranged along ventral margin of the claw (distinctly seen at 400x magnification). Median claw of tarsi II - IV reduced to a sclerite without denticles.

♂ - Length of idiosoma 440-469 μm . Dorsal aspect similar to that of female. GA (Fig. 10) with truncate anterior margin. GO large. Distance from anterior margin of GO to that of GA same as length of GO. Forty-two to sixty-seven pgs arranged in two rings around the GO, outer ring with 30-47 perigenital setae, inner ring with 12-18 setae. Pair of outlying setae on level with anterior setae of ring with perigenital setae. Genital sclerites with five pairs of spur-like sgs. Spermatopositor not reaching anterior margin of GA.

Juveniles - Dorsal plates more distinctly reticulated than in adults. Porose areolae not as raised as in adults but due to dense arrangement of canaliculi set off from remainder of plates. PD smaller than in adults. Deutonymphs 385-408 μm long. Genital plate rectangular, with broadly rounded angles, not fused with anal plate. Spines on leg I short. Genital plate with two pairs of minute subgenital setae close to

primordial genital opening and two pairs of perigenital setae. Protonymphs 290-334 μm long. Neither perigenital nor subgenital setae present on genital plate. Number of spines of leg I summarized in Table 1.

TABLE 1
Agauopsis brevipalpus, number of spines of leg I

	telofemur	genu	tibia	tarsus
Deutonymph	1vl, 2vm	1vl, 1vm	1vl, 2vm	1vm
Protonymph	1vl, 1vm	1vl, 1vm	1vl, 1vm	1vm

Variations - Out of 20 pairs of legs examined, one female has three spines on genu I.

Habitat: *Agauopsis brevipalpus* was commonly found, though never in large numbers, in samples with algae, from the upper littoral zone down to about 10 m depth, living amongst thickets of green, brown as well as red algae.

Remarks: With regard to the external morphological characters, the specimens from the Sevastopol area correspond with the holotype specimen from the French Atlantic coast.

CHICHKOFF (1907) described a 650-750 μm long variety, *Agauopsis brevipalpus* var. *pontica*. According to CHICHKOFF, *A. brevipalpus* var. *pontica* is larger than *A. brevipalpus brevipalpus*, and tibiae III and IV have two instead of three pectinate spines. When the characters are reevaluated, these differences do not exist. The somewhat depressed type of *A. brevipalpus* has an idiosomal length of 515 μm (530 μm according to TROUESSART, 1889b), its length to tip of rostrum is 625 μm . The length given by CHICHKOFF, which obviously includes the gnathosoma, is within the range of *A. brevipalpus*. The number of pectinate spines is the same.

The individuals described and illustrated by CHICHKOFF (1907) agree perfectly with the type specimen and the mites from the Sevastopol area, e.g., the dorsal plates have raised costae, the areas outside these costae are coarsely reticulated; the small triangular tectum of the gnathosoma extends to the end of P-I; the dorsal setae of the legs are rather long but the medial spines of leg I short; telofemora III and IV are almost twice as long as high; the claws of tarsi II and III have tines of claw pecten along their ventral flank. The ecological data, i.e. species wide-spread in the littoral but never occurring in large numbers (CHICHKOFF, 1907), also corresponds with that found to be true for *A. brevipalpus* in the Sevastopol area.

Distribution: Eastern North Atlantic, Mediterranean, Black Sea.

The records from the western Atlantic (LOHMANN, 1893; NEWELL, 1947), the Bay of Bengal (RAO & GANAPATI, 1968) and from off Sydney, Australia (LOHMANN, 1893) certainly are erroneous. A small collection of halacarids from the western Atlantic, from the Bermuda Islands and the Caribbean area (in the author's collection) includes two species of *Agauopsis* closely related but not conspecific with *A. brevipalpus*. A slide of Newell's halacarid collection (housed in the United States

National Museum of Natural History) from Soldiers Key, Florida, proved to contain not *A. brevipalpus* but a species most similar to *A. littoralis* Bartsch & Iliffe. In the Australian fauna, the genus *Agauopsis* is represented with several species, but according to present knowledge (OTTO, 1994, and unpublished data) none of them is conspecific with the eastern Atlantic *A. brevipalpus*.

***Agauopsis ibssi* sp. n.**

Figs 12-36

Agauopsis brevipalpus pontica, VIETS, 1928: 60-65, figs 31, 32.

not *Agauopsis brevipalpus pontica*, VIETS, 1940: 81, fig. 122.

Material Examined: Holotype ♀, paratype ♂, Crimea, Sevastopol, off Cape Chersonoc, coarse sediment, 10-12 m depth, 19 May 1995 (MHNG). Paratype ♀, same data as above (NMB). Paratype ♀ and male, same data as above (ZIMH A64/95). Eight paratype ♀, 5 ♂, 10 deutonymphs, 7 protonymphs, 4 larvae, same data as above (author's collection).

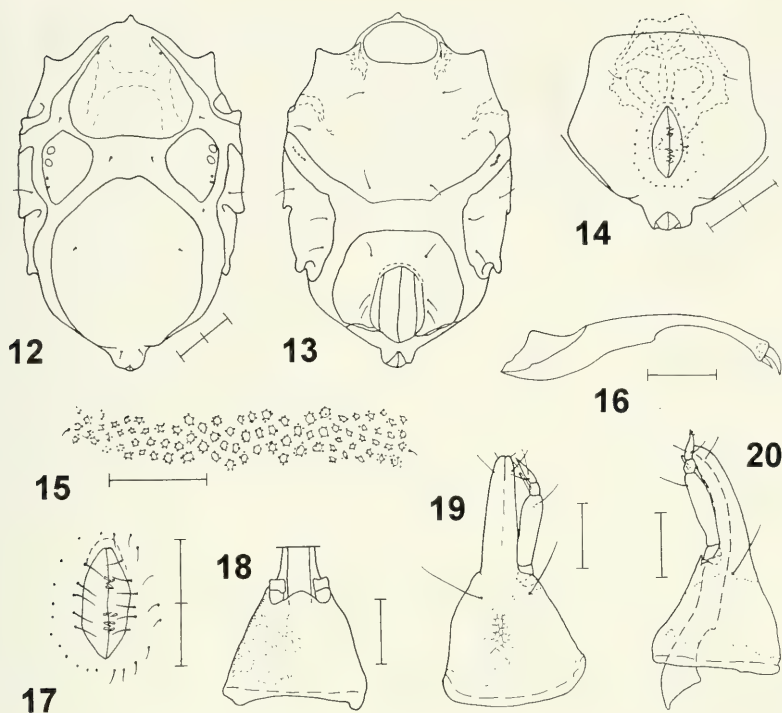
Three ♀, 4 ♂, Sevastopol, off Omega Bay, coarse sediment, 5-6 m depth, 6 May 1995 (author's collection).

Two ♂, Sevastopol, amphioxus sand, January 1912 (ZIMH, Collection Viets).

Description: ♀ - Idiosomal length 512-567 µm, holotype 570 µm long, 368 µm wide. Dorsal plates almost evenly ornamented with pycnic rosette pores. Each rosette pore with wide and shallow, pit-like ostium and, in deeper integumental layers, 6-10 canaliculi (Fig. 15). AD 195 µm long, 210 µm wide; with minute and blunt frontal process and very faintly developed H-like costa (Fig. 12). Small eye spot, 10-20 µm in diameter, beneath anterior portion of AD. First pair of gland pores in lateral margin of AD on level with insertion of leg I. OC 117 µm long, 90 µm wide, with rounded posterior angles. Lateral margin with two corneae, gland pore and pore canaliculus, and 22-27 µm long and 17 µm wide eye spot beneath corneae. PD 278 µm long, 247 µm wide. Anterior margin slightly concave as in holotype, but generally evenly rounded. Gland pores inconspicuous. Dorsal setae hardly more than 5-7 µm long. Setae ds-1 slightly anterior to pair of gland pores; ds-2 to ds-4 on minute sclerites within striated integument, ds-2 between AD and OC, ds-3 between OC and PD, ds-4 posterior to OC; ds-5 on PD anterior level with insertion of legs IV. Adanal setae in posterior margin of PD where PD and anal plate are fused.

Ventral plates with uniform ornamentation similar to that of dorsal plates. AE 222 µm long, 362 µm wide. Epimeral processes I and II lamella-like, coxal in origin. Epimeral pore with tube-like 12 µm long and 5 µm wide sacculus; opening to exterior through narrowed 10 µm wide slit. AE with three pairs of slender setae (Fig. 13). PE with a dorsal and three ventral setae. GA 212 µm long, 210 µm wide; wedges of striated integument between lateral portions of genital and anal plate. GO 120 µm long, 85 µm wide. Distance from anterior margin of GA to that of GO almost half length of GO. Three pairs of perigenital setae present, the two posterior pairs inserted adjacent to the GO. Subgenital setae lacking. Ovipositor in rest not extending beyond GO.

Gnathosoma 192 µm long, 105 µm wide. One pair of maxillary setae on gnathosomal base, one pair in apical fifth of rostrum. Tectum (Fig. 18) small, scale-like, extending to level with bases of P-1. Slender rostrum slightly shorter than gnathosomal base (Figs 19, 20). Palps slender. P-2 3.1-3.7 times longer than high. P-3

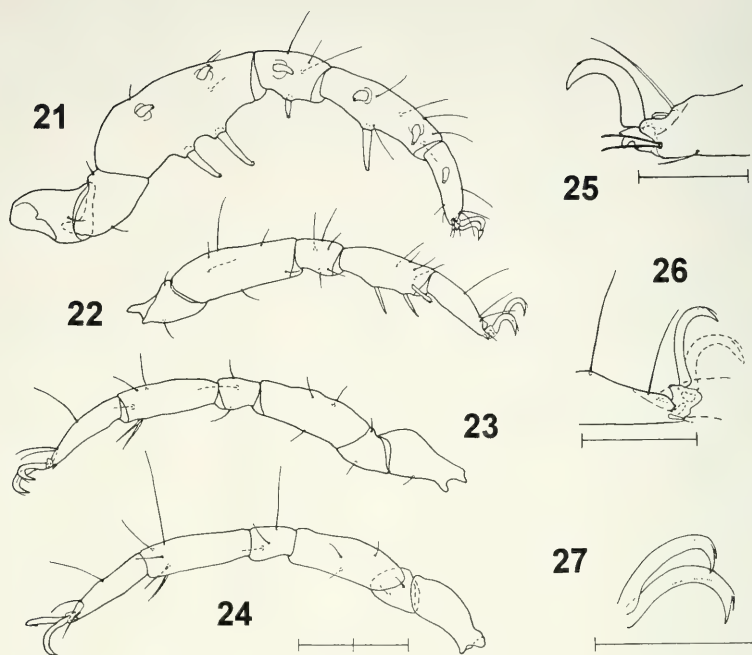


FIGS 12-20

Agauopsis ibssi sp. n., 12, idiosoma, dorsum, ♀; 13, idiosoma, venter, ♀; 14, genitoanal plate, ♂; 15, portion of PD between ds-5, ♀; 16, chelicera, medial, ♀; 17, genital opening, ♂; 18, gnathosomal base, dorsal, ♀; 19, gnathosoma, ventral, ♂ (porose areolae surrounded by stippled line); 20, gnathosoma, lateral, ♂ (porose areola surrounded by stippled line). (Each scale division = 50 µm)

with long, serrate and apically truncate spine; that spine slightly longer than length of P-3. P-4 with two setae in basal whorl and a setula and two spurs apically. Chelicera slender.

Leg I (Fig. 21) somewhat larger and distinctly stouter than legs II - IV (Figs 22-24). Telfemora slender, from I-3 to IV-3 2.4, 2.9, 2.8, and 2.8 times longer than high, and 1.4, 1.4, 1.1 and 1.0 times longer than their tibiae. Telfemora lack ventral lamellae and articular membranes; genua and tibiae lack articular membranes. Integument of lateral and dorsal flanks of telfemora, basifemora II - IV and trochanters III and IV pierced by canaliculi. Genua and tibiae with delicate canaliculi. Leg chaetotaxy, from trochanter to tibia (setae in arabic and spines in roman numerals): leg I, 1, 2, 4+IV, 3+II, 6+III; leg II, 1, 2, 6, 5, 7; leg III, 1, 2, 3, 3, 5; leg IV, 0, 2, 3, 3, 5. Dorsal setae slender. Telfemur I of holotype with four, otherwise often with five dorsal setae. Apical third of spines of leg I pectinate. Ventral spines of



FIGS 21-27

Agauopsis ibssi sp. n., 21, leg I, medial, ♀; 22, basifemur - tarsus II, medial, ♀; 23, leg III, medial, ♀; 24, leg IV, dorsomedial, ♀; 25, tip of tarsus I, lateral, ♀ (medial seta and claw omitted); 26, tip of tarsus II, medial, ♂ (medial setae and claw dashed); 27, claws of tarsus III, ♂. (Each scale division = 50 µm)

telofemur 42 and 48 µm, of genu 25 µm and of tibia 42 µm long, medial spines of I-3 36 and 40 µm, of I-4 39 µm, of I-5 42 and 36 µm and of I-6 25 µm long. Tibia II with three spine-like pectinate bristles; ventromedial bristle in its distal third widened and bipectinate. Tibiae III and IV with pair of spine-like, pointed and delicately pectinate bristles. Tarsus I distinctly shorter than tibia I. Medial membrane of claw fossa 2-3 µm wide; slightly larger lateral membrane (Fig. 25) with small solenidion and internal famulus. Membranes of claw fossa of tarsi II - IV 10 µm long, and 3-5 µm high. Solenidion of tarsus II (Fig. 26) inserted on inner flank of medial membrane of claw fossa. Apex of tarsus I with pair of doubled pas, that of tarsus II laterally with a long and a short seta-like pas, medially with a spur-like pas; lateral pas of tarsi III and IV spur-like, medial pas lacking.

Paired claws of tarsus I somewhat shorter and median claw larger than claws of succeeding tarsi. Median claw of tarsus I bidentate. Paired claws with minute accessory process, claws on tarsi II - IV with very delicate pecten. Pecten (Fig. 27) on

outer flank of claw with 10 tines, pecten on inner flank of claw with 22 tines (tines generally not seen by 400x magnification).

♂ - Idiosomal length 515-569 μm . Dorsal aspect same as that of female. Relative to its length GA wider than that of female; GA of 533 μm long paratype 247 μm long, 247 μm wide. GO 90 μm long, 35 μm wide. Distance from anterior margin of GO to that of GA same as length of GO (Fig. 14). With 25-34 perigenital setae arranged around GO; of these, generally five to six pairs of setae adjacent to and 14-22 setae in a ring around GO. Pair of outlying perigenital setae anterior to that ring with setae. Genital sclerites (Fig. 17) with five pairs of short subgenital setae. Spermatopositor extending somewhat beyond anterior margin of GA.

Juveniles - Dorsal and ventral plates smaller than in adults (Figs 28 - 33). PD with distinctly demarcated costae in that the ostia of the rosette pores are smaller within the costae than in remainder of the plate, namely 2-3 μm wide within the costae versus 5 μm wide outside the costae.

Deutonymph 397-484 μm long. Almost quadrangular genital plate with two pairs of pgs. Two pairs of small sgs adjacent to 10 μm long primordial genital opening, and two pairs of internal genital acetabula beneath genital area. Telfemora and tibia I (Fig. 34) each with a ventral and two ventromedial spines, I-4 with long ventromedial and short ventral spine, tarsus I with ventromedial spine. Tibia II with three spine-like setae; tibiae III and IV with pair of spine-like setae.

Protonymph 309-337 μm long. PD with pair of medial and lateral costae. Genital plate with single pair of genital acetabula; pgs and sgs lacking. I-3, I-4 and I-5 each with a ventral and a ventromedial spine, I-6 with ventromedial spine (Fig. 35). Tibiae II - IV each with pair of ventral setae.

Larva 213-235 μm long. PD short, medial and lateral costae distinct due to their more intense porosity and smaller ostia. Integument outside costae with large ostia and almost inconspicuous canaliculi. Genital plate lacking. No spines on telfemur I; genu I and tibia I with pair of pectinate spines, tarsus I with ventromedial spine (Fig. 36). Tibiae II and III with pair of setae, those of III-5 tapering. Claws of tarsus I slender.

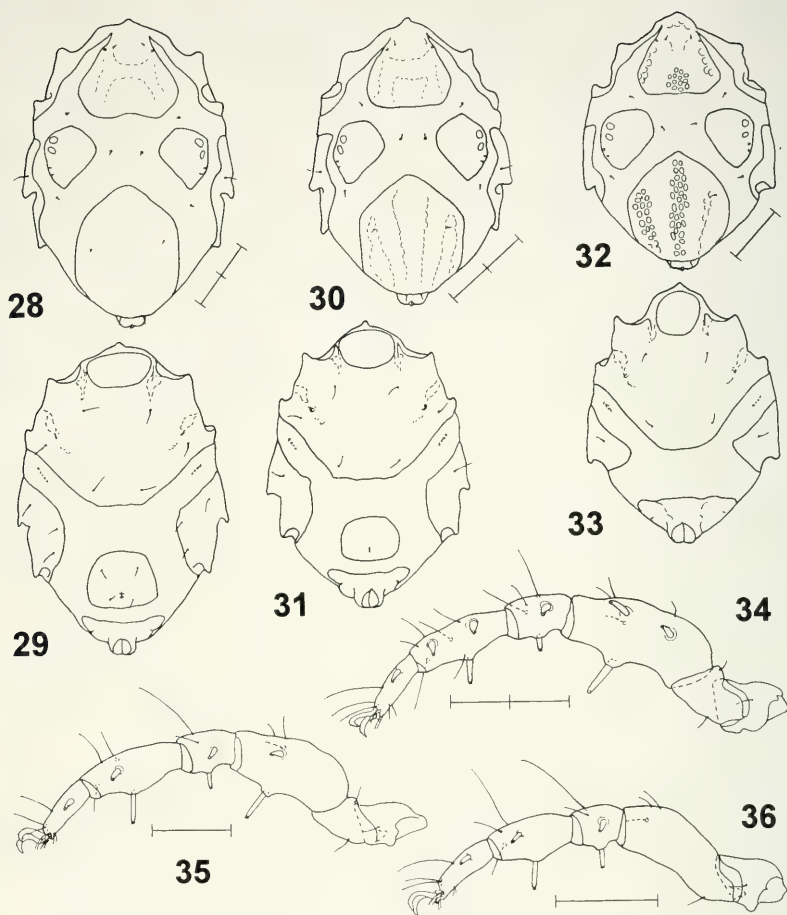
Variations - In one of 20 pairs of adult legs examined tibia III has three instead of two ventral bristles.

In one of the protonymphs the OC are fused with the PD.

Etymology: The species is named after the Institute of Biology of Southern Seas, IBSS, which was founded in 1871, 125 years ago.

Habitat: *Agauopsis ibssi* is an inhabitant of sublittoral sandy deposits. In the Sevastopol area the species was found in large numbers in coarse, unsorted amphioxus sand.

Remarks: *Agauopsis ibssi* differs from *A. brevipalpus* in that the PD is almost uniformly porose whereas the PD of *A. brevipalpus* has two pairs of costae; the dorsal setae are somewhat smaller and the ds-1 insert slightly anterior to the gland pores, the palps are 3.1-3.7 times longer than high, the tectum extends to level with bases of P-1, the telfemora III and IV are more slender than in *A. brevipalpus*, the tines of claw pecten are not recognizable at 400x magnification and the claws of tarsus I and the



FIGS 28-36

Agauopsis ibssi n. sp., 28, idiosoma, dorsum, deutonymph; 29, idiosoma, venter, deutonymph; 30, idiosoma, dorsum, protonymph; 31, idiosoma, venter, protonymph; 32, idiosoma, dorsum, larva; 33, idiosoma, venter, larva; 34, leg I, medial, deutonymph; 35, leg I, medial, protonymph; 36, leg I, medial, larva. (Each scale division = 50 μm)

spines of leg I are longer than in *A. brevipalpus*. Males of *A. ibssi* have a lower number of perigenital setae than males of *A. brevipalpus*; the pair of outlying setae inserts anterior to the ring of perigenital setae and the spermatopositor extends beyond the anterior margin of the GA, whereas in males of *A. brevipalpus* the pair of outlying setae is on a level with the anterior setae of the ring of pgs and the spermatopositor does not reach the anterior margin of GA.

In juveniles the differences in the ornamentation of the dorsal plates are not as marked as in adults; still, juvenile *A. ibssi* can be identified on the basis of the more uniform porosity of the dorsal plates and longer spines on leg I.

The two species also differ in their habitats, *A. brevipalpus* lives amongst dense scrubs of algae whereas *A. ibssi* is psammophilous.

Representatives of *A. ibssi* were present in the material from the Sevastopol area studied by VIETS (1928). Viets identified the specimens from amphioxus sand as *A. brevipalpus pontica* (Chichkoff). The characters of the psammophilous mites from the Sevastopol area are not in accordance with those presented by CHICHKOFF (1907) for *A. brevipalpus* var. *pontica*. The dorsal plates of *A. ibssi* are almost evenly ornamented and the spines of leg I are long; in contrast, the PD of the specimen illustrated by Chichkoff has distinct longitudinal costae and the spines are shorter. The telofemora of *A. ibssi* are relative to their length longer than in *A. brevipalpus*.

Agauopsis ibssi and *A. brevipalpus* are very closely related and may be suspected of being ecotypes, the individuals from sublittoral sandy deposits having more weakly ornamented idiosomal plates, less pronounced costae, more delicate setae, and more slender legs than animals living in dense algal scrubs on exposed or semi-exposed shores. Within the genus *Agauopsis* as well as in other genera, e.g. *Copidognathus*, psammobiont species generally have evenly reticulated, porose or smooth idiosomal plates; they lack prominently raised costae with rosette pores, and in brackish-water *Copidognathus* the ornamentation is less pronounced, costae and rosette pores are never as prominent as in exclusively marine species. Sclerotization may be influenced to a minor extent by the physical and chemical conditions in the habitat, but ecotypes with markedly differing sclerotization dependant on the environmental parameters in the niche inhabited have as yet not been reported on. Accordingly, *A. ibssi* and *A. brevipalpus* are considered as distinct species.

Distribution: Black Sea.

***Agauopsis marinovi* Petrova, 1976**

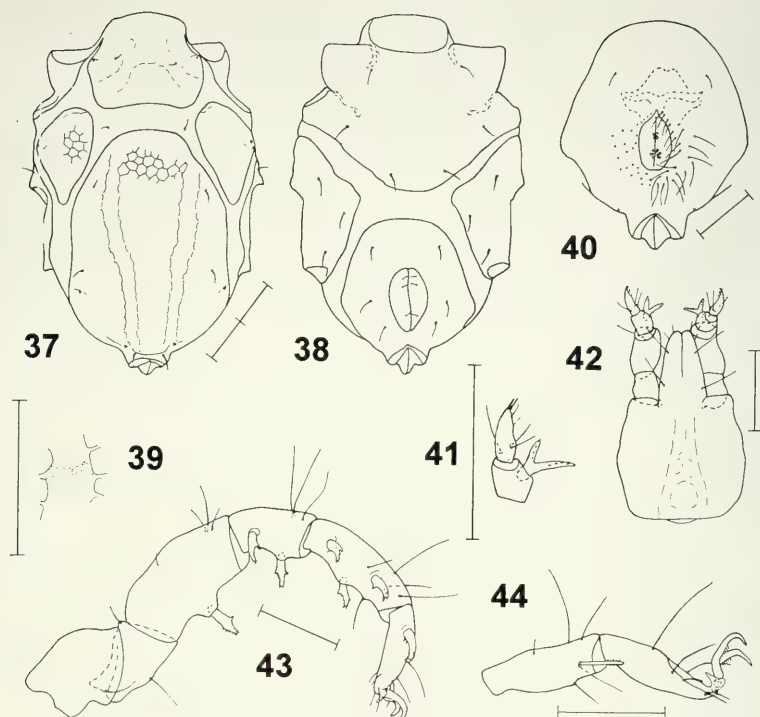
Figs 37-54

Agauopsis marinovi PETROVA, 1976: 67-70, fig 1.

Agauopsis aremorica Bartsch, 1984: 114-117, figs 1-17 (syn. n.)

Material Examined: One ♀, 1 ♂, 1 deutonymph, Crimea, Sevastopol, beach east of Omega, 0.5 m from water line toward land, 45 cm sediment depth, coarse, unsorted, very angular sediment, 24 May 1995 (MHNG); 1 ♀, collecting data as above (NMB); 1 ♀, collecting data as above (ZIMH A65/95); 7 ♀, 2 ♂, 6 deutonymphs, 7 protonymphs, 4 larvae, collecting data as above (author's collection). Four ♀, 1 ♂, 1 larva, same beach as above, 3 m from water line toward land, 45 cm sediment depth, coarse, unsorted sediment, 24 May 1995 (author's collection), .

Description: ♀ - Length of idiosoma 323-408 µm. Porose areolae with dense, very delicate punctation but major part of dorsal plates reticulate, each mesh in turn subdivided by delicate cuticular bars. Anterior margin of AD studded with 5 µm long cuticular filaments (Fig. 37); porose areola arch-like. Area along anterolateral margin of OC porose; corneae and eye pigment lacking. Pair of divergent costae on PD 15-20 µm wide and delicately punctated (Fig. 39).



FIGS 37-44

Agauopsis marinovi Petrova, 37, idiosoma, dorsum, ♀; 38, idiosoma, venter, ♀; 39, portion of left costa of PD posterior to ds-4, ♀; 40, genitoanal plate, ♂; 41, P-3 and P-4, ♀; 42, gnathosoma, ventral, ♀; 43, leg I, medial, ♀; 44, tibia and tarsus leg II, medial, ♀. (Each scale division = 50 µm)

AE without epimeral pores (Fig. 38). GA with three, rarely four pgs on either side of GO. Oblong genital sclerites with two anterior and one posterior pair of delicate sgs.

Outline of gnathosoma as in male (Fig. 42). Tectum truncate. P-3 (Fig. 41) with stout and divaricate denticulate spine. P-4 with three short setae in basal whorl and two minute setulae and two spurs apically.

Leg chaetotaxy, from trochanter to tarsus (setae in arabic and spines in roman numerals; solenidion excluded): leg I, 1, 2, 4+I, 3+II, 5+III, 7+I; leg II, 1, 2, 4, 5, (5)-6, 6; leg III, 2, 2, 2(-3), 4, 5, 6; leg IV, 1, 2, 3, 3, 5, 5. Spines on leg I conspicuously serrate (Fig. 43), telofemur I with ventral spine; genu I with pair of spines; tibia I with one ventral and two ventromedial spines. Ventromedial seta of II-5 bipectinate and distinctly wider than ventrolateral one (Fig. 44). III-5 and IV-5 each with slender ventromedial and distinctly longer and wider ventrolateral seta. Tarsus I with three

dorsal setae, slender 9 μm long dorsolateral solenidion and flap-like membrane with famulus, strongly serrate ventromedial spine, pair of slender ventral setulae and pair of apical pas. Tarsus II with three dorsal setae, seta-like 8 μm long dorsomedial solenidion, single ventral setula and pair of pas. Tarsi III and IV with four and three dorsal setae respectively, each with the two distal setae being flattened and delicately plumose. Apex of tarsi III and IV with pair of seta-like pas.

Claws of tarsus I smooth, claws of succeeding tarsi longer but more slender. Pecten with 6-7 tines in basal half of claws.

♂ - Idiosomal length 353-396 μm . In dorsal aspect similar to female. Anterior margin of GA (Fig. 40) more rounded than in female; with pair of outlying setae and 44-50 pgs around the GO.

Juveniles - Idiosomal length of deutonymphs 282-328 μm . PD smaller and more slender than in adults, anteriorly rounded (Fig. 45). Genital plate and anal plate fused (Fig. 46). Genital plate with two pairs of pgs. Leg chaetotaxy similar to that of adults; leg I (Fig. 47) with same number of spines as adults have.

Idiosomal length of protonymph 205-254 μm . OC short, PD slender (Fig. 48). PE with a dorsal and a single ventral seta. Genital and anal plate fused (Fig. 49); perigenital setae lacking. Number of setae (arabic numerals) and spines (roman numerals) of leg I (Fig. 50), 1, 2, 3+I, 2+II, 3+II, 7+I. In one of the protonymphs both tibiae have two pairs of spines (Fig. 51).

Length of larva 157-192 μm . AE with two pairs of setae (Fig. 52) and a pair of epimeral pores (Fig. 53), each pore with 5 μm long internal tube. Genital plate lacking. Number of setae (arabic numerals) and spines (roman numerals) of trochanter, femur, genu, tibia and tarsus I (Fig. 54): 1, 4, 2+II, 3+II, 7+I.

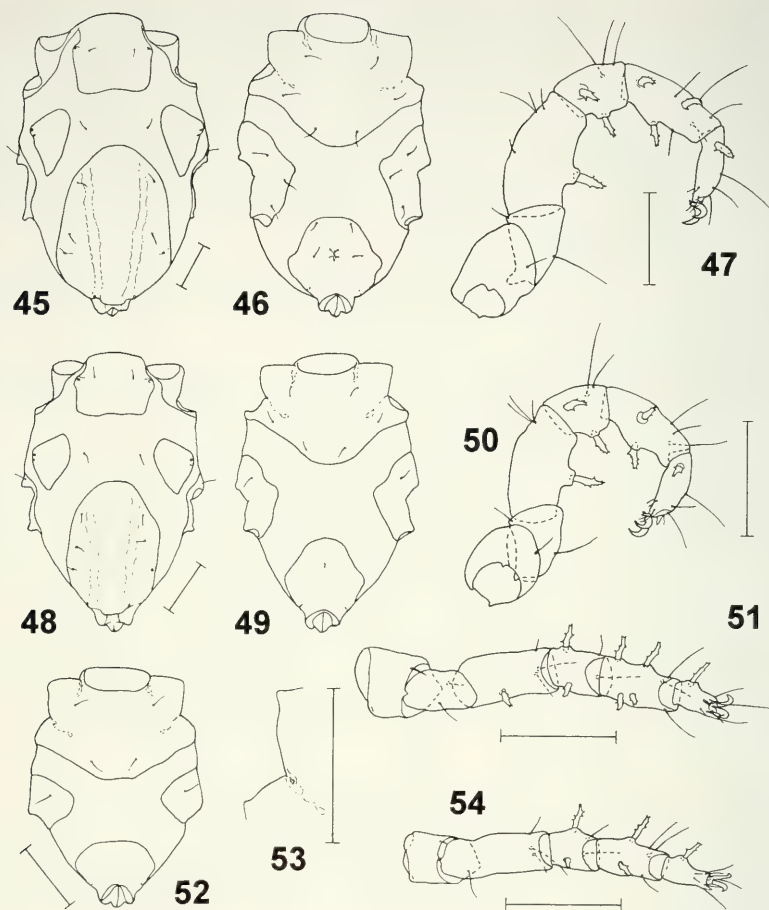
Habitat: *A. marinovi* was found in large numbers in 45 cm sediment depth, 0.5 to 3 m from the water edge toward the land, in a beach area regularly washed by waves. Their number rapidly decreased towards the permanently inundated beach area.

Remarks: The specimens from the Sevastopol area are considered as conspecific with *A. marinovi*, a species reported from the Bulgarian Black Sea coast. The ventromedial bristle of tibia II is widened and bipectinate, a character not mentioned in PETROVA (1976).

A. aremorica Bartsch, recorded from northern France (BARTSCH, 1984), has a similar bipectinate ventromedial bristle. In general facies, specimens from the eastern Atlantic coast agree perfectly with those from the Black Sea.

A. marinovi is easily separated from *A. brevipalpus* and *A. ibssi* on the basis of the divaricate spine on P-3 and the coarsely denticulate spines of leg I. In contrast to the two latter species, P-4 has three setae in the basal whorl, both pairs of maxillary setae insert on the rostrum; tarsi III and IV each have a pair of pas, and tarsus III has four dorsal setae; the deutonymphs and protonymphs have genital and anal plate fused. The pair of delicately porose costae of the PD resembles that often present in species of the genus *Halacarellus*.

Distribution: Spread in the Black Sea area. Present also in beaches of the eastern North Atlantic.



FIGS 45-54

Agauopsis marinovi Petrova, 45, idiosoma, dorsum, deutonymph; 46, idiosoma, venter, deutonymph; 47, leg I, medial, deutonymph; 48, idiosoma, dorsum, protonymph; 49, idiosoma, venter, protonymph; 50, leg I, medial, protonymph; 51, leg I, ventral, protonymph; 52, idiosoma, venter, larva; 53, portion of right AE with epimeral pore, larva; 54, leg I, ventral, larva. (Each scale division = 50 μ m)

ACKNOWLEDGEMENT

I am indebted to Prof. V. E. Zaika, director of the Institute of Biology of the Southern Seas (IBSS), Dr N. Shalovenkov, T. Nikolaenko, E. Kolesnikova and the staff of the Institute for all the help during my stay at Sevastopol. Thanks are also due to Dr H. Dastych, Hamburg, M. H. Naudo, Paris, and R. Smiley, Beltsville, for loan

of halacarid mites stored in the museums. The study of the halacarid fauna of Sevastopol area, Crimea, was supported by the Deutsche Forschungsgemeinschaft which is gratefully acknowledged.

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***Stiliderus* and *Stilicoderus*: New data and new species
(Coleoptera, Staphylinidae, Paederinae)***

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***Stiliderus* and *Stilicoderus*: New data and new species (Coleoptera, Staphylinidae, Paederinae).** - A systematic catalogue of the species of *Stiliderus* and *Stilicoderus* is presented. Fifteen new species are described. Males of two known species are described for the first time. Eleven species are recorded for the first time from China; nine species are described from Sulawesi, all of them endemic. Species are recorded for the first time from other countries.

Key-words: Coleoptera - Staphylinidae - Paederinae - *Stiliderus* - *Stilicoderus* - China - Sulawesi.

INTRODUCTION

In the nine years that have elapsed since the publication of a series of articles, including a revision in two parts of this group, other species have been described, and a large volume of new material has passed through my hands. Material studied in this paper comes in part from my own occasional prospections in Asia, but the largest contribution comes from recent collections made by I. Löbl and others for the Geneva Natural History Museum. Further material was provided by the Natural History museums in London and Vienna. The study of large collections from Australia in the Australian National Insect Collection, Canberra, and the Field Museum of Natural History, Chicago, is to be published separately, as a review of the Australian fauna (ROUGEMONT, 1996).

In the present paper, apart from the descriptions of new species or of previously undescribed male sex characters, I have only included such new data as significantly adds to our knowledge of species distribution, such as first records for countries or major islands.

Although in my earlier papers I followed Blackwelder's synonymy of *Stilicoderus* with *Stiliderus*, I have gone on thinking of these as distinct genera, and reverted to labelling specimens as such according to the character state of the fourth tarsomeres (In the paper on the Australian fauna all species are described as *Stilicoderus*).

* 29th contribution to the knowledge of Staphylinidae

Manuscript accepted 04.12.1995.

The problem of defining these two genera lies in reconciling the presence of bi-lobed fourth tarsomeres with the absence of the other main character state, an infra-orbital ridge on the post-genae, in thirteen species belonging to three separate phyletic groups: the *praecellens* group, the *magniceps-duplicatus* group and the *brendelli* group (see catalogue, below). While the first two groups may be '*Stilicoderus*' that have independantly evolved bi-lobed tarsomeres, the celebesian *brendelli* group is clearly more closely affiliated to *Stiliderus* s. str.

The status of these two genera can only be resolved by a study of all genera of the subtribe Stilicina, for the genus *Stilicoderus*, as it is defined at present to include such aberrant forms as the *funebis* and *aberrans* groups, may also include certain New World genera, which I have not seen, such as *Stilicolina* Casey. Since a much needed generic revision of the subfamily Paederinae is currently under preparation by Dr Lee Herman of the American Museum of Natural History, I will not attempt any further discussion of generic status, but propose the following division into species groups.

SYSTEMATIC CATALOGUE OF *Stilicoderus* AND *Stiliderus*

Species group	Sub-group	Species	Distribution
<i>Stilicoderus</i>			
<i>funebis</i> group		<i>funebis</i> Last <i>kiloloensis</i> Last <i>nubilus</i> Last	New Guinea New Guinea New Guinea
<i>japonicus</i> group = <i>Stilicoderopsis</i> Scheerp.		<i>formosanus</i> n. sp. <i>japonicus</i> Shibata <i>scheerpeltzi</i> (Rgmt.)	Taiwan Japan, China Burma
<i>granulifrons</i> group		<i>granulifrons</i> (Rgmt.)	Himalaya, Assam, Thailand
<i>umbratus</i> group		<i>besucheti</i> (Rgmt.) ssp. <i>elephantium</i> (Rgmt.) <i>umbratus</i> Fv.	S. India: Anaimalai Hills S. India: Palni Hills S. India: Nilgiri Hills
<i>feae</i> group		<i>bakeri</i> Cam. <i>bruneipennis</i> Cam. <i>drescheri</i> Cam. ssp. <i>baliensis</i> (Rgmt.) <i>feae</i> Fv. <i>kuani</i> Shibata <i>leontopolitanus</i> (Rgmt.) <i>malaisei</i> Scheerp. <i>plumbatus</i> (Rgmt.) <i>shan</i> (Rgmt.) <i>similis</i> (Rgmt.) <i>strigellus</i> Cam. <i>unicolor</i> Cam.	Philippines, Borneo ? Java Java Bali Himalaya, Burma, Thailand Taiwan Thailand, Malaysia, Sunda Islands E. Himalaya, Burma Sumatra Burma, Thailand Burma, Thailand Sumatra Borneo

	<i>birmanus</i> Scheerp.	Burma, Yunnan
	<i>clayi</i> (Rgmt.)	Assam
	<i>fenestratus</i> Fv.	Himalaya, Burma, Thailand
<i>feae-discalis-</i> <i>signatus</i> group	<i>incognitus</i> (Rgmt.)	Burma
	<i>kambaitiensis</i> Scheerp.	Burma
	<i>lomholdti</i> (Rgmt.)	Thailand
	<i>maai</i> (Rgmt.)	Borneo
	<i>nepalensi</i> (Rgmt.)	Nepal
	<i>pendleburyi</i> Cam.	Malaysia
	<i>siamensis</i> (Rgmt.)	Thailand
	<i>signatus</i> Sharp	Japan, China
	n. sp. (Shibata, in litt.)	Taiwan
	<i>discalis</i> group	
	<i>bacchusi</i> (Rgmt.)	Borneo
	<i>discalis</i> Fv.	Burma, Thailand, Vietnam
	<i>strigosus</i> (Rgmt.)	Assam S. to Sumatra
<i>minor</i> group	<i>exiguus</i> Shibata	Taiwan, China
	<i>minor</i> Cam.	E. Himalaya, China
<i>variolosus</i> group	<i>gondaicus</i> n. sp.	S. India
	<i>helferi</i> (Rgmt.)	Burma, Yunnan, Thailand
	<i>nagamontium</i> (Rgmt.)	Assam
	<i>parvus</i> Cam.	Thailand, Sunda Islands
	<i>rotundiceps</i> Cam.	Malaysia
	<i>trapezeiceps</i> (Rgmt.)	Thailand, Yunnan
	<i>variolosus</i> Coiff.	Himalaya
<i>hieroglyphicus</i> group	<i>ferromontis</i> Rgmt.	Australia
	<i>hieroglyphicus</i> Fv.	New Guinea
	<i>hornabrooki</i> (Rgmt.)	New Guinea
	<i>kaiensis</i> n. sp.	Kai Islands
	<i>leai</i> (Rgmt.)	New Guinea
	<i>loksai</i> (Rgmt.)	New Guinea
	<i>madangensis</i> (Rgmt.)	New Guinea
	<i>maritimus</i> (Rgmt.)	New Guinea, Waigeo
	<i>sharpi</i> (Rgmt.)	New Guinea
	<i>wallacei</i> (Rgmt.)	New Guinea
	<i>wauensis</i> (Rgmt.)	New Guinea, Solomon Islands
<i>aerosus</i> group	<i>aerosus</i> Last	New Guinea
	<i>lasti</i> (Rgmt.)	New Guinea
	<i>peninsularis</i> Rgmt.	Australia
	<i>solitarius</i> Last	New Guinea
<i>aberrans</i> group	<i>aberrans</i> Steel	Australia
	<i>arnhemicus</i> Rgmt.	Australia
	<i>inuitatus</i> Rgmt.	Australia
	<i>matthewsianus</i> Rgmt.	Australia
	<i>newtoni</i> Rgmt.	Australia
	<i>orbiceps</i> Rgmt.	Australia
	<i>pruinus</i> Rgmt.	Australia
	<i>quadriceps</i> Rgmt.	Australia
	<i>taylori</i> Rgmt.	Australia
	<i>woodwardi</i> Rgmt.	Australia

Stiliderus s. l.
(infra-orbital reidge lacking)

<i>praecellens</i> group	<i>praecellens</i> Bnh.	Philippines: Mindoro
<i>magniceps</i> group	<i>cottoni</i> n. sp. <i>magniceps</i> Cam.	Thailand Java
<i>magniceps</i> - <i>duplicatus</i> group	<i>depressus</i> n. sp.	Thailand
<i>duplicatus</i> group	<i>duplicatus</i> Ito	Riuku Islands
<i>brendelli</i> group	<i>brendelli</i> Rgmt. <i>conicollis</i> n. sp. <i>kakihitam</i> n. sp. <i>kakimerah</i> n. sp. <i>opacipennis</i> n. sp. <i>opacus</i> n. sp. <i>schoedli</i> n. sp. <i>yangbesar</i> n. sp.	Sulawesi Sulawesi Sulawesi Sulawesi Sulawesi Sulawesi Sulawesi Sulawesi
	<i>Stiliderus</i> s. str.	
<i>cicatricosus</i> group	<i>ancora</i> Bnh. <i>bakerianus</i> Bnh. <i>bernhaueri</i> Rgmt. <i>brevipennis</i> Bnh. <i>capitalis</i> Bnh. <i>cardamomensis</i> n. sp. <i>celebensis</i> Rgmt. <i>cernatus</i> Rgmt. <i>cicatricosus</i> Mots. <i>crassus</i> Kr <i>densissimus</i> Bnh. <i>expectatus</i> Rgmt. <i>flavomarginatus</i> Bnh. <i>kamarupensis</i> Rgmt. <i>latericarinatus</i> Bnh. <i>loebli</i> Rgmt. <i>longicollis</i> Bnh. <i>longipennis</i> Bnh. <i>micropterus</i> Bnh. <i>mussardi</i> Rgmt. <i>nigerrimus</i> Bnh. <i>nitidipennis</i> Bnh. <i>occidentalis</i> Rgmt. <i>pulchripennis</i> Bnh. <i>semicoeruleus</i> Rgmt. <i>simoni</i> Rgmt. <i>smetanai</i> Rgmt. <i>yikor</i> n. sp. <i>yunnanensis</i> n. sp.	Philippines: Masbate, Mindoro Philippines: Mindanao Philippines: Luzon Borneo, Sumatra Philippines: Leyte, Mindanao S. India Sulawesi Sumatra Burma, Thailand, Yunnan, Malaysia Sulawesi, India, SE Asia Philippines: Mindanao Thailand, Malaysia, Sunda Islands Philippines: Luzon, Mindoro Assam Philippines: Mindoro Assam Palawan, Borneo Philippines: Luzon Philippines: Mindanao S. India Philippines: Luzon Philippines: Luzon, Leyte, Saman W. Himalaya Philippines: Luzon, Leyte Philippines: Mindoro Ceylon Nepal Thailand, Yunnan Yunnan

SYSTEMATIC LIST

Stilicoderus Sharp*japonicus* group**Stilicoderus formosanus** n. sp.

♂ Holotype, 1 ♀ Paratype: Taiwan, Nantou Hsien, Shanlinchi 1600 m, 16.V.1990, A. Smetana (T60); 1 ♂ Paratype: Taiwan, Taoyuan Hsien, Takuanshan For., 17.IV.90, 1650 m, A. Smetana (T5) (in coll. Smetana, eventually to be deposited in Mus. Geneva; ♂ Paratype in coll. Rougemont).

Length: 6–6.5 mm.. Black, mouthparts, antennae and legs brown, all surfaces shiny, devoid of microsculpture.

Proportions of Holotype: Length and breadth of head: 92; diameter of eye: 20; antennomeres: I: 30; II: 14; III: 15; IV: 14; V: 13; VI: 12; VII: 11; VIII: 11; IX: 11; X: 10; XI: 15. Length of pronotum: 86; breadth of pronotum: 81; length of elytron: 100; breadth of elytra: 96; Metatarsomeres: I: 19; II: 10; III: 10; IV: 8; V: 16.

Similar in punctuation to *S. japonicus* Shibata, but the head and pronotum differently shaped (Fig. 1, cf. Fig. Shibata 1968), the head not ovoid, the temples dilated posteriorly, with well marked postero-lateral angles; pronotum less elongate, broader at anterior angles. Granulose punctuation of occipital region more extensive and coarser; granulose punctuation of pronotum coarser and denser; granulose punctuation of elytra interspersed with deeper and larger foveate depressions than in *S. japonicus*.

The head of the Paratype from Takuanshan is somewhat less dilated posteriorly than in the exx. from Shanlinchi.

Male: Abdominal sternite VIII (Fig. 8) deeply emarginate, but more narrowly so than in *S. japonicus*, the apico-lateral angles not produced into narrow lobes. Aedeagus: Fig. 18, similar in structure to that of *S. japonicus*, but the apex of ventral blade characteristic (cf. Fig. 50 A, ROUGEMONT, 1986a).

granulifrons group**Stilicoderus granulifrons** (Rougemont)

Stiliderus granulifrons ROUGEMONT, 1985b, *Rev. Suisse Zool.* 92, 1: 224; ROUGEMONT, 1986a, *Ent. Abh. Mus. Tierk. Dresden* 49, 8: 174.

1 ♀: Nepal: Khandbari District, For. above Ahale 2400 m, 25.III.82, A. & Z. Smetana; 1 ♀: Nepal, Khandbari District, Forest NE Kuwapani 2400 m, 24.IV.84, Smetana & Löbl; 1 ♂ & 1 ♀: Nepal, *ibid.*, 28.III.82, A. & Z. Smetana (coll. Smetana); 2 exx.: Nepal, Sankhua Sabha Distr., Arun Valley between Mure and Hurure, mixed broad-leaved forest 2050–2150 m, 9–17 June 1988, Martens & Schawaller leg. (Mus. Stuttgart); 3 exx.: Thailand, Chiang Mai, Doi Inthanon 1650 m, 7.XI.1985, Burckhardt-Löbl; 3 exx.: Thailand, Chiang Mai, Doi Suthep 1400 m, 6.XI.1985, Burckhardt-Löbl; 1 ♀: Thailand, Huai Nam Dang, Mae Taeng Distr. 1400 m, 17.XII.1990, P. Schwendinger (Mus. Geneva); 2 ♂♂ & 1 ♀: Thailand, Chiang Mai, Doi Pui, III.1987, G. de Rougemont (coll. Rougemont).

New to Thailand and to Nepal. This species was described from the single female Type from the Karen Hills of Burma. The male was later described from the Khasi Hills of Meghalaya (NE India). Males among the new material from all three states, Thailand, Meghalaya and Nepal, show characteristic differences in the aedeagus which are however too slight to warrant the descriptions of subspecies. While the Nepalese exx. have distinctly smaller, especially narrower, elytra than those from other areas, the forms are otherwise indistinguishable by external characters. The forms from both Nepal and Thailand differ from the Meghalayan population by the more slender ventral blade and parameroid lobes. The Thai race is distinguished from the Nepalese one by the shape of the parameroid lobes which are longer, and particularly the right lobe, apically explanate (Figs. 19, 20).

The aedeagus of the nominate form is almost certainly identical with that of the Thai race.

feae-signatus-discalis group

***Stilicoderus feae* Fauvel**

Stilicoderus feae Fauvel, 1895, *Rev. d'Ent.* 14: 224.

Stiliderus feae, ROUGEMONT 1986a, *Ent. Abh. Mus. Tierk. Dresden* 49, 8: 177.

4 ♂♂ & 1 ♀: China, Yunnan, Xishuangbanna, Mengdian; 22.I.1993, G. de Rougemont; 1 ♀: China, Yunnan, Ruili, 3.II.1993, G. de Rougemont (coll. Rougemont).

Widely distributed from the Himalaya to Thailand. New to China.

***Stilicoderus similis* Rougemont**

Stiliderus similis ROUGEMONT, 1986a, *Ent. Abh. Mus. Tierk. Dresden*, 49, 8: 177.

1 ♂: Thailand, Chiang Mai, Doi Pui, III.1987, G. de Rougemont (coll. Rougemont). 2 ♂♂, 1 ♀: Doi Suthep, Chiang Mai, Thailand, I.V.1990, T. Ito.

This species was described from the single Type from the Shan States of Burma. It is new to Thailand.

More new material attributable to *S. leontopolitanus* Rougemont, described in ROUGEMONT (1986a: 179), shows that this taxon is both variable and widespread: I have seen exx. ranging from southern Thailand (Chantaburi Province, Khao Sabap N.P., 23.XI.85, Burckhardt-Löbl), the Cameron Highlands, Malaysia (tentative determination based on females), Singapore, Sumatra and Bali (5 exx: Batukau. 18.VI.1984, Rougemont). The morphological variability suggests that these two taxa may be conspecific, the apparent differences now seem to be limited to the narrower impunctate band of the pronotum and the longer ventral blade of the aedeagus in *S. similis*. I will not formally propose the synonymy until more material becomes available from continental SE Asia.

***Stilicoderus plumbatus* (Rougemont)**

Stiliderus plumbatus ROUGEMONT, 1986a, *Ent. Abh. Mus. Tierk. Dresden* 49, 8: 174.

2 ♂♂ & 2 ♀♀: Sumatra, Jambi, Mt. Kerinci 1750–1850 m, 11–12.XI.1989, Agosti, Löbl, Burckhardt (Mus. Geneva).

Hitherto only known by the three female Types.

Male: Abdominal sternite VIII with a deep, finely margined emargination (Fig. 9). Aedeagus: Fig. 21.

***Stilicoderus birmanus* Scheerpeltz**

Stilicoderus birmanus Scheerpeltz, 1965, *Ark. Zool.* 17: 181.

Stiliderus birmanus, ROUGEMONT 1986a, *Ent. Abh. Mus. Tierk. Dresden* 49, 8: 166.

1 ♀: China, Yunnan, Kunming, 9.X.1985, G. de Rougemont.

This species was only known by the single Type from Kambaiti, Burma: New to China.

***Stilicoderus maai* (Rougemont)**

Stiliderus maai ROUGEMONT, 1986a, *Ent. Abh. Mus. Tierk. Dresden* 49, 8: 168.

Colleagues Burckhardt and Löbl collected 58 exx. of this Bornean endemic, previously only known by two females, from various localities on Mount Kinabalu, and from the Crocker Range: 1600 m, km 51 rte Kinabalu-Tambunan, 18.V.1987, and I took a further 3 exx. from Mount Kinabalu in March 1990. The male sex characters may now be described:

Abdominal sternite VII broadly and very shallowly excised, with a double row of fine setae; sternite VIII broadly and deeply emarginate, the apico-lateral angles each with a single seta (Fig. 10); aedeagus (Fig. 22) with a pair of broad lamellate parameroid lobes from between which protrude paired, ploughshare-shaped inner struts. Urite IX broad, the tergite emarginate, apico-laterally with numerous stout setae of unequal length.

This material shows that the differences given between the Type and the specimen from Pangl in the original description are within the range of variability of a single species.

***Stilicoderus fenestratus* Fauvel**

Stilicoderus fenestratus Fauvel, 1895, *Rev. d'Ent.* 14: 225.

Stiliderus fenestratus; ROUGEMONT, 1986a, *Ent. Abh. Mus. Tierk. Dresden* 49, 8: 169.

4 exx.: China, Yunnan, Xishuangbanna, Mengdian, 22.I.1993, G. de Rougemont.

New to China.

***Stilicoderus strigosus* (Rougemont)**

Stiliderus strigosus ROUGEMONT, 1985b, *Rev. Suisse Zool.* 92, 1: 219; ROUGEMONT 1986a, *Ent. Abh. Mus. Tierk. Dresden* 49, 8: 163; ROUGEMONT 1986, *Ann. Hist. Nat. Mus. Nat. Hung.* 78: 80.

2 exx.: Thailand, NE Bankok, Khao Yai Nat. Park, E Heo Suwat waterfalls 800–900 m, 1.XII.1985, Burckhardt-Löbl; 30 exx.: Thailand, Phetchaburi, Kaeng Krachan Nat. Pk. 450 m, 19.XI.1985, Burckhardt-Löbl (Mus. Geneva); 3 exx.: Thailand, 300 m, Thung Yai Wildlife

Sanctuary, 15°28'N 98°48'E, Tak Province, Omphang District, Song Bae stream, 18–27.IV.1988, evergreen rain forest, M.J.D. Brendell (BMNH); 14 exx.: Thailand, Chiang Mai, Doi Pui, III.1987, G. de Rougemont; 28 exx.: China, Yunnan, Xishuangbanna, Mengdian, 22.I.1993, G. de Rougemont (coll. Rougemont).

The new material from China and from Khao Yai and Thung Yai are typical *S. strigosus*, but the series from Phetchaburi Province represent a new form characterised by the shape of the very stout ventral blade of the aedeagus (Fig. 23, cf. Figs 2B and 2C, ROUGEMONT 1985b). It may be that both this form and the one localized in Meghalaya (ROUGEMONT 1985b) both merit subspecific status, but more material is needed from possible interfaces to determine this.

S. bacchusi Rougemont, of which we also have new material (19 exx.: Sabah, Poring Hot Springs, 500 m, 13.V.1987, Burckhardt-Löbl, and 1 ♂ & 1 ♀: Ibid., 9.III.1990, G. de Rougemont), is the Bornean representative of *S. strigosus*, and in consistence with the eventual naming of the two forms mentioned above should perhaps also be regarded as a subspecies of *S. strigosus*.

minor group

Stilicoderus minor Cameron

Stilicoderus minor Cameron, 1931, *Faun. Brit. Ind., Col. Staph.* 2: 253.

Stiliderus minor, ROUGEMONT 1985b, *Rev. Suisse Zool.* 92, 1: 219; ROUGEMONT 1986 a, *Ent. Abh. Mus. Tierk. Dresden* 49, 8: 162.

5 ♂♂ & 1 ♀: Nepal, Raswa Distr. 1.5 km NE Bhargu 2000 m, 12.IV.85, A. Smetana; 1 ♂ & 1 ♀: Nepal, Khandbari Distr., For. NE Kuwapani 2500 m, 28.III.1982, A. & Z. Smetana, 2 ♂♂ & 2 ♀♀: Nepal, Khandbari District, Bakan W of Tashigaon 3200 m, 4.IV.1982, A. & Z. Smetana; 2 ♂♂ & 2 ♀♀: Nepal, Khandbari District, Induwa Khola Valley 2000 m, 14.IV.1984, Smetana & Löbl (coll. Smetana); 1 ♀: China, Yunnan, Kunming, 9.X.1985, G. de Rougemont; 2 ??: Ibid., X.1986, G. de Rougemont; 1 ♂ & 1 ♀: China, Gansu, Maijishan, VIII.1986, G. de Rougemont; 1 ♂ & 1 ♀: China, Shaanxi, Nanwutai, 17.IX.1995, G. de Rougemont (coll. Rougemont).

Known from Darjeeling and Bhutan. New to Nepal and China.

Stilicoderus exiguitas Shibata

Stilicoderus exiguitas Shibata, 1974, *Bull. Jap. Ent. Acad.* 8, 1: 11.

Stiliderus exiguitas, ROUGEMONT 1986a, *Ent. Abh. Mus. Tierk. Dresden* 49, 8: 162.

17 exx.: China, Guizhou, Huaxi near Guiyang, X.1986, G. de Rougemont.

This is the sister-species of *S. minor* Cam., and assumed until now to be endemic to Taiwan. Although both species are now known to occur on the continent, they may still be allopatric, *S. exiguitas* occupying a more easterly range than *S. minor*.

Both species are very similar, but *S. exiguitas* is readily identifiable, given comparison material, by its broader, more quadrate head, with more prominent posterior angles and consequently more rectilinear base. In addition the sides of the pronotum are more convex, and the apex of the ventral blade is less strongly recurved than in *S. minor*. Differences in proportions of the fore-bodies are as follows: Length/breadth of head: *S. minor*: 76:78; *S. exiguitas*: 81:86; length/breadth of pronotum: *S. minor*: 78:74; *S. exiguitas*: 81:80.

variolosus group

***Stilicoderus parvus* Cameron**

Stilicoderus parvus Cameron, 1936, *Tijdschr. Ent.* 79: 46.

Stilicoderus parvus, ROUGEMONT 1986a, *Ent. Abh. Mus. Tierk. Dresden* 49, 8: 162.

1 ♂ & 1 ♀: Thailand, Chiang Rai, Nam tok Ban Du, III.1987, G. de Rougemont; 10 exx.: Sabah, Poring Hot Springs, 500 m, 7.V.1987, Burkhardt-Löbl; 3 exx.: Java, Cibodas 50 km E of Bogor, 1400 m, 3–6.XI.1989, Agosti, Löbl, Burckhardt; 3 exx.: Sumatra, Aceh, Mt. Leuser NP, 300–500 m, Ketambe, 23–30.XI.1989, Löbl, Agosti, Burckhardt (Mus. Geneva); 2 ♀ ♀: Sumatra, 29.II.1982, Sibolangit, Indonesia leg. Schillhammer (Mus. Vienna).

Hitherto only known by the singler Type from Java.

***Stilicoderus trapezeiceps* (Rougemont)**

Stiliderus trapezeiceps ROUGEMONT, 1986a, *Ent. Abh. Mus. Tierk. Dresden* 49, 8: 161.

1 ♂: China, Yunnan, Xishuangbanna, Mengdian, 22.I.1983, G. de Rougemont; 1 ♀: China, Yunnan, Ruili, 3.II.1983, G. de Rougemont.

This species was previously only known from northern Thailand, where I obtained a further series from the type locality in March 1987.

***Stilicoderus helferi* (Rougemont)**

Stiliderus helferi ROUGEMONT, 1985b, *Rev. Suisse Zool.* 92: 218; ROUGEMONT, 1986a, *Ent. Abh. Mus. Tierk. Dresden* 49, 8: 159.

1 ♂: Thailand, Khlong Nathan Wildlife sanctuary, Kapoe District, 30 m, P. Schwen-dinger; 3 ♂ ♂ & 1 ♀: China, Yunnan, Ruili, 3.II.1993, G. de Rougemont.

This species is otherwise only known by the single Type from Burma (see description of *S. gondaicus* n. sp., below).

***Stilicoderus gondaicus* n. sp.**

Stiliderus helferi ROUGEMONT, 1985b, pro parte, *Rev. Suisse Zool.* 92: 218.

♂ Holotype, 30 ♂ ♂ & 17 ♀ ♀ Paratypes: India, Kerala, Cardamom Hills between Pambanar and Peermade 950 m, 9.XI.1972, Besuchet, Löbl, Mussard (Mus. Geneva); 6 exx.: S. India, Kerala, Cardamom Hills, 10 km, SW Kumily 77°07'E 09°31'N, Vallakadavu 1000 m, 24.XII.1993 leg. Boukal & Kejval; 15 exx.: S. India, Tamil Nadu, Nilgiri Hills, 15 km SE Kotagiri (3), Kunchanappanai 900 m, 70°56'E 11°22'N leg. Boukal & Kejval (Mus. Vienna). (Type series in Mus. Geneva, 5 Paratypes in coll. Rougemont).

The Type series of this new species was determined as *S. helferi* Rgmt. in ROUGEMONT (1985b). In that article I expressed some doubt about the provenance of the Type of *S. helferi* (Burma). The rediscovery of *S. helferi* in Thailand and Yunnan and re-examination of the material shows that these are distinct, allopatric species: *S. gondaicus* n. sp. in South India, and *S. helferi* Rgmt. in continental SE Asia.

The two species are so similar that a full description of *S. gondaicus* would be superfluous. *S. gondaicus* n. sp. differs from *S. helferi* in the finer and denser punctuation of the fore-body, especially noticeable on the head, where the diameter of punctures scarcely exceeds that of eye-facets, whereas they are very much larger than eye-facets in *S. helferi*.

In other members of the *varlosus* group the male eighth sternite is broadly and very shallowly emarginate. In both *S. helferi* and *S. gondaicus* n. sp. the sternite has a 'false emargination' before the shallowly emarginate posterior border, consisting of a semi-circular depression, the fundus of which is translucent, much more thinly sclerotised than the surrounding cuticle, appearing in certain lights as a deep emargination. The shape and pubescence of this depression differs slightly in each species (Figs 11, 12). The difference in the shape of the parameroid lobes of the aedeagus is illustrated in ROUGEMONT (1985b: Fig. 1A (*S. helferi*, Holotype) and Figs 1B & 1C (*S. gondaicus* n. sp.).

hieroglyphicus group

***Stilicoderus wauensis* (Rougemont)**

Stiliderus wauensis ROUGEMONT, 1986d, *Ann. Hist.-Nat. Mus. Nat. Hung.* 78: 80.

A long series of this species, which I described from a single ex. from Wau in the New Guinea highlands, had escaped my notice in the collection of the BMNH, where they stood among undetermined material under the label *Rugilus*. This new material comes from several of the Solomon Islands: SE Santa Ysobel, 1000 Ships Bay opp. Lilihini Is., 20.IX.1965, shore litter, P.N. Lawrence, Roy. Soc. Exped. Brit. Mus. 1966-1; Kolombangara, nr. Kuzu, 3-8.IX.1965, forest litter, P.N. Lawrence, Royal Soc. Exped. B.M. 1966-1; Guadalcanal, Mt. Austen, 14.VIII.1963, P. Greenslade, B.M. 1966-477.

The *hieroglyphicus* group comprises nine known species from mainland New Guinea, one from the Kai Islands, and one from North Queensland. All of them are so closely related and similar in appearance that they can only be determined by examination of the aedeagus, which affords good diagnostic characters in all cases. The occurrence of this New Guinea species in the Solomons, where one might have expected an endemic representative of the group, is noteworthy: either it is an accidental introduction, or, if its presence is the result of natural dispersion, it may also be expected to occur in New Ireland and New Britain.

The records of *S. hieroglyphicus* Fv. given by LAST (1984) include several members of this group, one of which I later described as *S. madangensis* (ROUGEMONT 1986d). The figure he gave of the aedeagus of '*S. hieroglyphicus*' appears to be that of *S. wauensis* (cf. Fig. 4, ROUGEMONT 1986d).

***Stilicoderus kaiensis* n. sp.**

♂ Holotype, 6 ♂♂ & 9 ♀♀ Paratypes: Indonesia: Maluc., Kai Besar, G. Dob 400 m, Agosti, 5.IX.91 (6), F11047, leaf litter (Mus. Geneva, 5 Paratypes in coll. Rougemont).

Length: ca. 5 mm. Externally in all respects similar to *S. hieroglyphicus* Fv. and other members of this group.

Proportions: Length of head: 68; breadth of head: 75; length of antenna: 128; length of pronotum: 70; breadth of pronotum: 60; length of elytron: 81; breadth of elytra: 77; metatarsus: 40.

Male: Abdominal sternites VII and VIII built as in *S. hieroglyphicus*; aedeagus (Fig. 24) characteristic, in particular by virtue of the asymmetrical parameroid lobes.

Stiliderus Motschoulsky s. l. (infra-orbital ridge lacking)

Thirteen known species of *Stiliderus* lack any trace of a cephalic infra-orbital ridge; these are *S. praecellens* Bnh. from the Philippines, which stands phyletically isolated, the eight members of the endemic Celebesian *brendelli* group described below, and the following four species which also appear to form one or two monophyletic lines. With the partial exception of *S. duplicatus* Ito, which has a more convex build, these four species resemble the *Stilicoderus discalis* group in facies more closely than they do typical *Stiliderus*. They may be separated from each other as follows:

- 1 Elytral punctuation densely granulose between the large serially aligned foveate punctures 2
- Elytra smooth and shiny between the large serially aligned foveate punctures, the ground punctuation simple, sparse, and extremely fine 3
- 2 Larger species, over 6 mm long; male 7th sternite emarginate; aedeagus: Fig. 19A, ROUGEMONT (1986e). Java *magniceps* Cam.
- Smaller species, under 5 mm long; male 7th sternite unmodified; aedeagus: Fig. 27. Thailand *cottoni* n. sp.
- 3 Dorsal surfaces of fore-body more convex; aedeagus: Fig. 26. Riuku Islands *duplicatus* Ito
- Fore-body strongly depressed, as in *S. magniceps* and *S. cottoni*; aedeagus: Fig. 25. Thailand *depressus* n. sp.

magniceps-duplicatus group**Stiliderus duplicatus** (Ito)

Stilicoderus duplicatus Ito, 1984, *Ent. Rev. Japan* 39: 59. Type: Amami-Oshima Island, Japan.

ITO (1984) attributed this species to *Stilicoderus*, presumably on the basis of the absence of an infra-orbital ridge and the insect's facies, remarking that it 'differs clearly from all other *Stilicoderus* species in having the tarsal segments such as those of *Stiliderus*'. Thanks to his kindness in sending me a Paratype for my reference collection, I am able to establish its phyletic position next to the following new species.

Stiliderus depressus n. sp.

♂ Holotype, 3 ♂♂ & 1 ♀ Paratypes: Thailand, Chiang Mai, Doi Pui ca. 1100 m, III.1987, G. de Rougemont (Mus. Geneva, coll. Rougemont); 1 ♀ Paratype: Thailand, Doi Suthep, 1050 m, 5.XI.1985, Burckhardt-Löbl; 3 ♀♀ Paratypes: Thailand, NE Bangkok, Khao Yai Nat. P. E Heo Suwat waterfalls 800–900 m, 1.XII.1985, Burckhardt-Löbl; 1 ♀: Thailand, Taksin, Maharat N.P. 1000 m, 9.II.1993, Schwendinger; 1 ♀: Thailand, Huai Nam Dang, Mae Taeng Distr. 1100 m, 17.12.1990, P. Schwendinger (Mus. Geneva).

Length: 5.6 mm. Fore-body black, post antennal tubercles reddish; abdomen pitchy-brown; labrum, mouthparts, antennae and legs reddish-brown, the femora, and in some exx., the first antennomere infusate.

Proportions of Holotype: Length of head: 75; breadth of head: 81; diameter of eye: 25; antennomeres: I: 25; II: 9; III: 12; IV: 11.5; V: 10; VI: 9; VII: 8.5; VIII-X: 8; XI: 13; length of pronotum: 67; breadth of pronotum: 72; length of elytron: 80; breadth of elytra: 90; metatibia: 63; metatarsomeres: I: 10; II: 7; III-V together: 21.

Length: ca. 5.7 mm. Upper surface of body depressed, as in members of the *Stilicoderus discalis* group. Pubescence of fore-body pale, fine, fairly long and dense.

Head strongly transverse, postero-lateral angles prominent, the base almost rectilinear; post-genae not bordered. Eyes large and protruberant (outline of fore-body: Fig. 2). Punctuation of vertex coarse, the punctures very much larger than eye-facets, elongate, the interstices on average about half the diameter of punctures, shiny, flattened, tending to fuse longitudinally anteriorly. Labrum broad, distinctly 5-dentate, the normal pair of lateral denticles broad, triangular, the extra lateral pair also relatively broad. Antennae moderately long, with all segments except the penultimate two distinctly elongate.

Pronotum transverse; mid-longitudinal band broad (ca. 7), flattened, f fusing posteriorly with a transverse shiny callus which is narrow at centre, broad on either side. Granules on disc prominent, their diameter about equal to cephalic punctures, each clearly isolated by narrow shiny interstices.

Elytra sub-quadrate, a little transverse, smooth and shiny, the large serially aligned foveate punctures deep, large (diameter 3-4) and numerous, the ground punctuation simple, extremely fine, almost invisible but for the fine pale pubescence which it bears.

Legs robust, tarsomeres broad; lobes of tarsomeres IV very long and broad.

Male: Sternite VII unmodified; sternite VIII with a small, shallow emargination (Fig. 13). The aedeagus (Fig. 25), like that of *S. duplicatus*, is of an unusual structure: ventral plate small, without salient processes; right parameroid lobe twisted, its asymmetrically flared apex lying in the median axis, the left, strongly asymmetrical parameroid lobe also twisted to lie above the right, in half lateral view resembling a dorsal plate (this disposition is more clearly seen in the aedeagus of *S. duplicatus*: Fig. 26).

Female: Abdominal tergite IX shiny, sparsely punctate and pubescent, with a small, acute apical emargination.

This new species most closely resembles *S. duplicatus* Ito, but is at once distinguished by its depressed build, by the basal callus of the pronotum (obsolete in *S. duplicatus*), by the somewhat less dense pronotal granulation, smaller emargination of male VIIIth sternite, and by the shorter and differently shaped parameroid lobes.

***Stiliderus cottoni* n. sp.**

♂ Holotype: Thailand, Chiang Mai, Doi Pui ca. 1100 m, III.1987, G. de Rougemont (Mus. Geneva); 1 ♂ Paratype: Doi Suthep, Chiang Mai, Thailand, 25.IV.1992, T. Ito (coll. Ito).

Length: 4.8 mm. Head, pronotum and elytra black; abdomen and femora pitchy black; labrum, antennae, tibia and tarsi dark reddish brown, the antennal scapes somewhat infuscate.

Proportions of Holotype: Length of head: 60; breadth of head: 67; diameter of eye: 20; antennomeres: I: 20; II: 9; III: 10; IV: 9; V: 8; VI: 7; VII: 7; VIII: 6; IX: 7; X: 8; XI: 12. Length of pronotum: 65; breadth of pronotum: 58; length of elytron: 73; breadth of elytra: 78; metatarsomeres: I: 9; II: 8; III–V together: 17.

Facies (outline of fore-body: Fig. 3), relative proportions, sculpture, punctuation and bi-lobed fourth tarsomeres very similar to *S. magniceps* Cam., but on a smaller scale (cf. redescription of *S. magniceps* in ROUGEMONT 1986e: 50).

Male: Abdominal sternite VII unmodified; sternite VIII (Fig. 14) with a small simple emargination; aedeagus (Fig. 27) similar to that of *S. magniceps*, elongate, the ventral blade navicular, symmetrical.

This is the sister species of *S. magniceps* Cam. and as such readily distinguishable from all other *Stiliderus* species. It differs from *S. magniceps* by its smaller size and the male sex characters: unmodified sternite VII, smaller emargination of sternite VIII, and the aedeagus (cf. Fig. 19, ROUGEMONT 1986e).

KEY TO THE *Stiliderus* OF SULAWESI

Descriptions of the first two *Stiliderus* from the island of Sulawesi were published in 1985 (ROUGEMONT 1985a). New material recorded in this paper raises the number of species to nine. The species fall into two phyletic groups: *S. celebensis* Rgmt belongs to *Stiliderus* s. str. (= *cicatricosus* group) and is closely related to *S. longicollis* Bnh. from Palawan and north Borneo, while the other eight species form a close-knit endemic group.

- 1 Postgenae with a prominent infra-orbital ridge; coarse punctuation of head close, the interstices tending to form longitudinal rugae; granules of pronotum coarse, each clearly isolated by narrow shiny interstices; base of pronotum with a broad shiny callus before posterior margin. aedeagus: Fig. 2A ROUGEMONT 1985a. *celebensis* Rgmt.
- Postgenae not bordered; punctuations of head sparser, not forming rugae; granules of pronotum small, tending to coalesce in parallel oblique rows forming a chevron pattern; pronotum devoid of a transverse shiny callus (*brendelli* group) 2
- 2 Head, midlongitudinal keel of pronotum and elytra shiny, devoid of microsculpture 3
- Head, midlongitudinal keel of pronotum with distinct microsculpture; elytra very densely microsculptate, opaque 7
- 3 Larger species, ca. 7 mm long; pronotum less elongate (3:2.7); elytra more transverse (4:3); male unknown *yangbesar* n. sp.
- Smaller species, 5–6.5 mm long; pronotum more elongate (3:2.7); elytra less transverse (ca. 4:3.5) 4
- 4 Smaller species, ca. 5 mm long; head transverse, with prominent posterior angles and proportionately larger, more prominent eyes (plate 1B, ROUGEMONT 1986e); male 8th sternite simply emarginate; aedeagus: Fig. 1A, ROUGEMONT 1985a *brendelli* Rgmt.

- Larger species, 5.5–6.5 mm long; head suborbicular, not transverse, with smaller, less prominent eyes (Fig. 4); male 8th sternite deeply and broadly excised to postero-lateral angles, these bearing a brush of long setae (Fig. 15) 5
- 5 Larger species, 6–6.5 mm; head distinctly elongate; pronotum strongly elongate (3:2), strongly convergent in straight lines in anterior 3/8ths (Fig. 5); male unknown *conicollis* n. sp.
- Smaller, (5.5–6 mm), less elongate species; sides of pronotum convexly rounded in anterior half 6
- 6 Averagely smaller species; femora reddish-brown; aedeagus: Fig. 28 *kakimerah* n. sp.
- Averagely larger species; femora black; aedeagus: Fig. 29. . . . *kakihitam* n.sp.
- 8 Smaller species, head ca. 80 long and broad; head and midlongitudinal keel of pronotum shiny, with strong transverse microreticulate ground sculpture; aedeagus: Fig. 30 *opacipennis* n. sp.
- Larger species, head ca. 90 long and broad; head and midlongitudinal keel or pronotum very strongly microsculptate, almost as densely opaque as elytra; aedeagus: Fig. 31 *opacus* n. sp.
- 7 Head transverse, with distinct posterior angles; the base almost rectilinear; male 8th sternite shallowly emarginate; aedeagus: Fig. 32. . . *schoedli* n.sp.
- Head orbicular, the base and temples coarctate; male 8th sternite deeply and broadly excised to postero-lateral angles, these bearing a brush of long setae 8

brendelli group

***Stiliderus kakimerah* n. sp.**

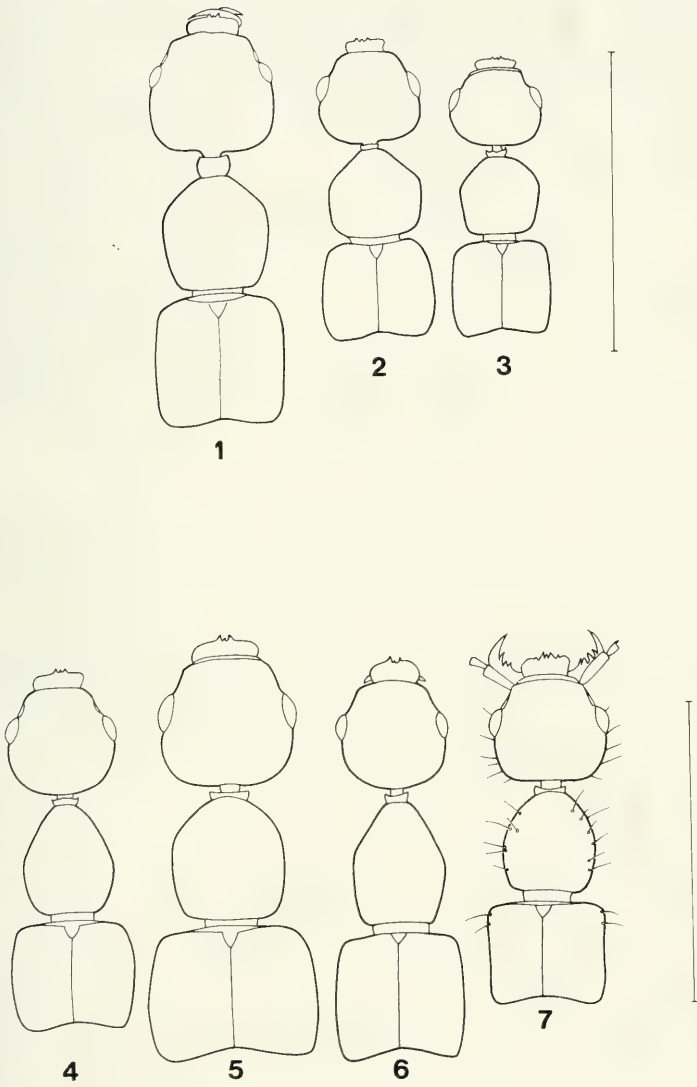
♂ Holotype, 6 ?? & 14 ♀♀ Paratypes: Indonesia, Sulawesi Utara, Danau Mooat 1200 m nr. Kotamobagu, Feb. 1985, Lower montane forest 1200–1400 m. Foliage of fallen tree (BMNH, 5 Paratypes in coll. Rougemont).

Length: 5.5–5.9 mm. Black, abdomen pitchy-brown to pitchy-black; mouth-parts, antennae and legs rufous. Fore-body very shiny, devoid of microsculpture.

Proportions: Length of head: 80; breadth of head: 80; diameter of eye: 25; antennomeres: I: 33; II: 12; III: 16; IV: 15; V: 15; VI: 15; VII: 14; VIII: 12; IX: 11; X: 11; XI: 17; length of pronotum: 83; breadth of pronotum: 68; length of elytron: 94; breadth of elytra: 94; metatarsi: I: 13; II: 8; III–V together: 21.

Outline of fore-body: Fig. 4. Similar to *S. brendelli* Rgmt. in colour, sculpture, punctuation and pubescence, but larger, the head sub-orbicular, with no trace of posterior angles, the temples and base coarctate, and male secondary sexual characters different.

Male: Abdominal sternite VII unmodified; sternite VIII (Fig. 15) with posterior margin entirely excised to postero-lateral angles, these bearing a brush of long setae, the emargination fringed with long setae. Aedeagus: Fig. 28, the ventral blade apically with a membranous flange of varying development and shape.



FIGS 1-7

Outline of fore-body (scale: 3 mm): 1. *Stilicoderus formosanus* n. sp.; 2. *Stiliderus depressus* n. sp.; 3. *Stiliderus cottoni* n. sp.; 4. *Stiliderus kakimerah* n. sp.; 5. *Stiliderus yangbesar* n. sp.; 6. *Stiliderus conicollis* n. sp.; 7. *Stiliderus schoedli* n. sp.

Stilicoderus kakihitam n. sp.

♂ Holotype 2 ♂♂ & 2 ♀♀ Paratypes: Indonesia, Sulawesi Utara, Danau Mooat 1200 m nr. Kotamobagu, Feb. 1985, Lower montane forest 1200–1400 m, foliage of fallen tree; 2 ♂♂ Paratypes: Indonesia, Sulawesi Utara, Gng. Ambang F.R. nr. Kotamobagu, 25 Jan. 1985, Lower montane forest 1400–1600 m, leaf litter; 1 ♂ Paratype: Ibid., Feb. 1985, leaf litter on log, 1300 m (BMNH, 5 Paratypes in coll. Rougemont).

Length: 5.5–6.7 mm. Colour as in *S. kakimerah*, but femora pitchy black, antennae and tibia a darker, reddish-brown.

Proportions: Length and breadth of head: 80; diameter of eye: 25; length of pronotum: 81; breadth of pronotum: 65; length of elytron: 81; breadth of elytra: 105.

Externally indistinguishable from *S. kakimerah* except for the colour of legs and slightly broader elytra. The average size of specimens is slightly greater.

Male: Abdominal sternites VII and VIII as in *S. kakimerah*. Aedeagus: Fig. 29, similar to *S. kakimerah*, but the ventral blade less angled in the middle, more strongly twisted to the left, the apex more dilated and without a broad convaluted membranous flange, but only a small triangular flange before the apical dilatation.

Stiliderus yangbesar n. sp.

♀ Holotype & 1 ♀ Paratype: Indonesia, Sulawesi Utara, Dumoga-Bone N.P., 19–26 June 1985, plot B. ca 300 m, Lowland forest, malaise trap, R. Ent. Soc. Lond. Project Wallace, BM 1985–10; 1 ♀ Paratype: Indonesia, Sulawesi Utara, Danau Mooat 1200 m, nr. Kotamobagu, Feb. 1985, Lower montane forest 1200–1400 m, foliage of fallen tree (BMNH, 1 Paratype in coll. Rougemont).

Outline of fore-body: Fig. 5. A much larger insect than the two preceding species, but similar in sculpture and punctuation. Head distinctly transverse, with broadly rounded but well marked apico-lateral angles. Pronotum very convex, much less elongate. Elytra proportionately shorter, more transverse.

Male unknown.

Stiliderus conicollis n. sp.

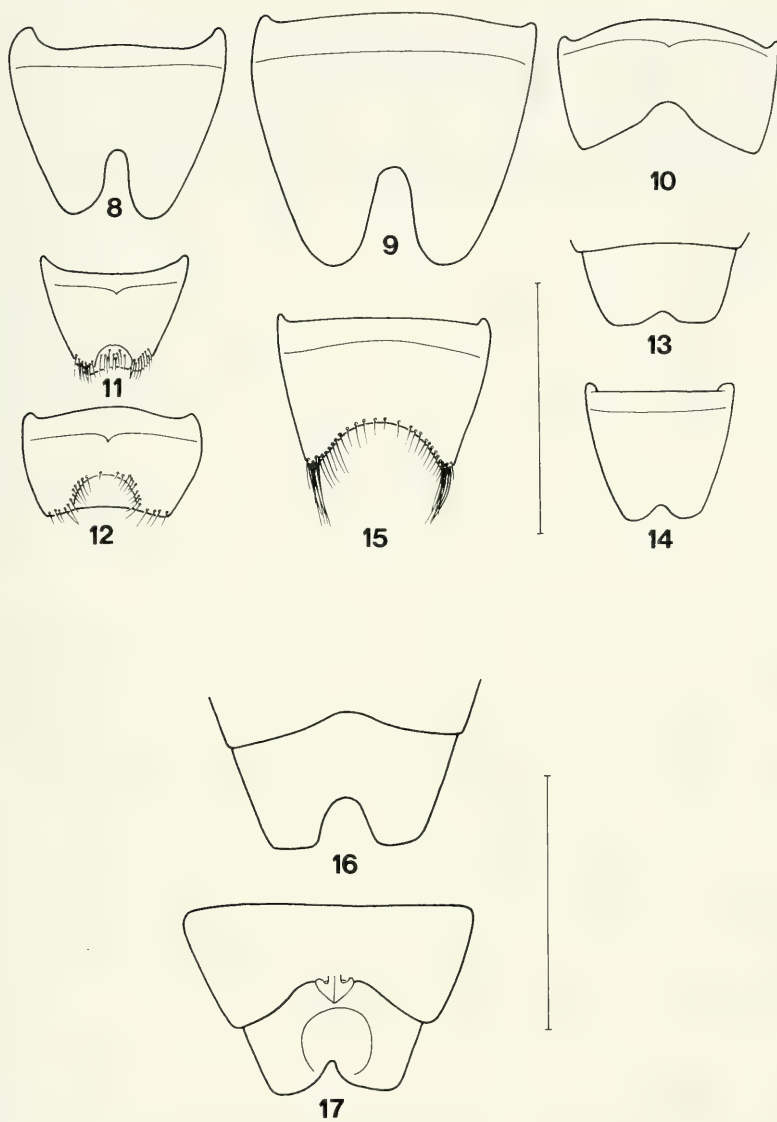
♀ Holotype & 1 ♀ Paratype: Sulawesi Selatan, W. of Mamasa 1600 m, 9.V.1991, D. Agosti F91724 (Mus. Geneva, Paratype in coll. Rougemont).

Length: 6.1–6.5 mm. Fore-body black, abdomen and femora pitchy-black, mouthparts, antennae, tibia and tarsi brown.

Proportions: Length of head: 89; breadth of head: 80; diameter of eye: 26; antennomeres: I: 39; II: 12; III: 18; IV: 16; V: 16; VI: 16; VII: 14; VIII: 13; IX: 11; X: 11; XI: 20. Length of pronotum: 90; breadth of pronotum: 68; length of elytron: 90; breadth of elytra: 103.

Outline of fore-body: Fig. 6. Sculpture and punctuation similar to that of *S. kakimerah* n. sp. and other preceding species, but punctuation of head sparser and a little coarser, that of pronotum coarser, the parallel lines of granules longitudinal anteriorly, oblique only in posterior half. Head sub-orbicular, distinctly elongate, the temples and base coarctate. Pronotum very elongate, the sides convergent in straight lines in anterior 3/8ths. Elytra rather depressed. Abdomen exceptionally broad (Maximum breadth 113 across urite V), with very broad paratergites.

Male unknown.



FIGS 8-17

Outline of male sternite VIII (scale: 1 mm): 8. *Stilicoderus formosanus* n. sp.; 9. *Stilicoderus plumbatus* Rgmt.; 10. *Stilicoderus maaï* Rgmt.; 11. *Stilicoderus helferi* Rgmt.; 12. *Stilicoderus gondaicus* n. sp.; 13. *Stiliderus depressus* n. sp.; 14. *Stiliderus cottoni* n. sp.; 15. *Stiliderus kakimerah* n. sp.; 16. *Stiliderus cardamomensis* n. sp.; 17. *Stiliderus yikor* n. sp.

***Stiliderus opacipennis* n. sp.**

♂ Holotype & 1 ♀ Paratype; Sulawesi Selatan, W. Manasa (sic) 1600 m, 9.04.1991, D. Agosti F91722/4 (Mus. Geneva, Paratype in coll. Rougemont).

Length: ca. 6.4 mm. Black, mouthparts, antennae, pro- and mesotibia and tarsi reddish-brown.

Proportions: Length of head: 85; breadth of head: 79; diameter of eye: 24; antennomeres: I: 37; II: 10; III: 18; IV: 16; V: 16; VI: 15; VII: 14; VIII: 13; IX: 12; X: 11; XI: 19. Length of pronotum: 82; breadth of pronotum: 68; length of elytron: 87; breadth of elytra: 97.

In facies resembling *S. conicollis* n. sp., the head distinctly elongate, but pronotum less elongate, and abdomen a little less broad. Punctuation of fore-body finer and denser than that of *S. conicollis*. Immediately distinguishable from the four preceding species by the microsculptate fore-body: On the head and mid-longitudinal keel of pronotum the microsculpture is strong, but still leaves the surface lustrous, whereas on the elytra it is so dense that the surface is entirely matt.

Male: Sternites VII and VIII as in *S. kakimerah* n. sp., the apico-lateral angles of sternite VIII furnished with a brush of long dark setae, but the emargination between them without conspicuous long setae. Aedeagus: Fig. 30.

***Stiliderus opacus* n. sp.**

♂ Holotype: Sulawesi Selatan, W. of Mamasa 1600 m, D. Agosti F91765 (Mus. Geneva).

Length: 6.5 mm. Colour, facies and punctuation as in *S. opacipennis* n. sp.

Proportions: Length of head: 95; breadth of head: 93; diameter of eye: 26; antennomeres: I: 41; II: 11; III: 21; IV: 18; V: 18; VI: 18; VII: 17; VIII: 13.5; IX: 12; X: 11; XI: 19. Length of pronotum: 97; breadth of pronotum: 78; length of elytron: 93; breadth of elytra: 100.

Very similar to *S. opacipennis* n. sp., but larger, the head orbicular, scarcely elongate, and punctuation of head and pronotum finer and denser. Microsculpture of head and mid-longitudinal keel of pronotum much denser, the surfaces not lustrous as in *S. opacipennis*, almost as densely matt as that of elytra. Elytra quadrate, depressed, densely, opaquely sculptured as in *S. opacipennis*.

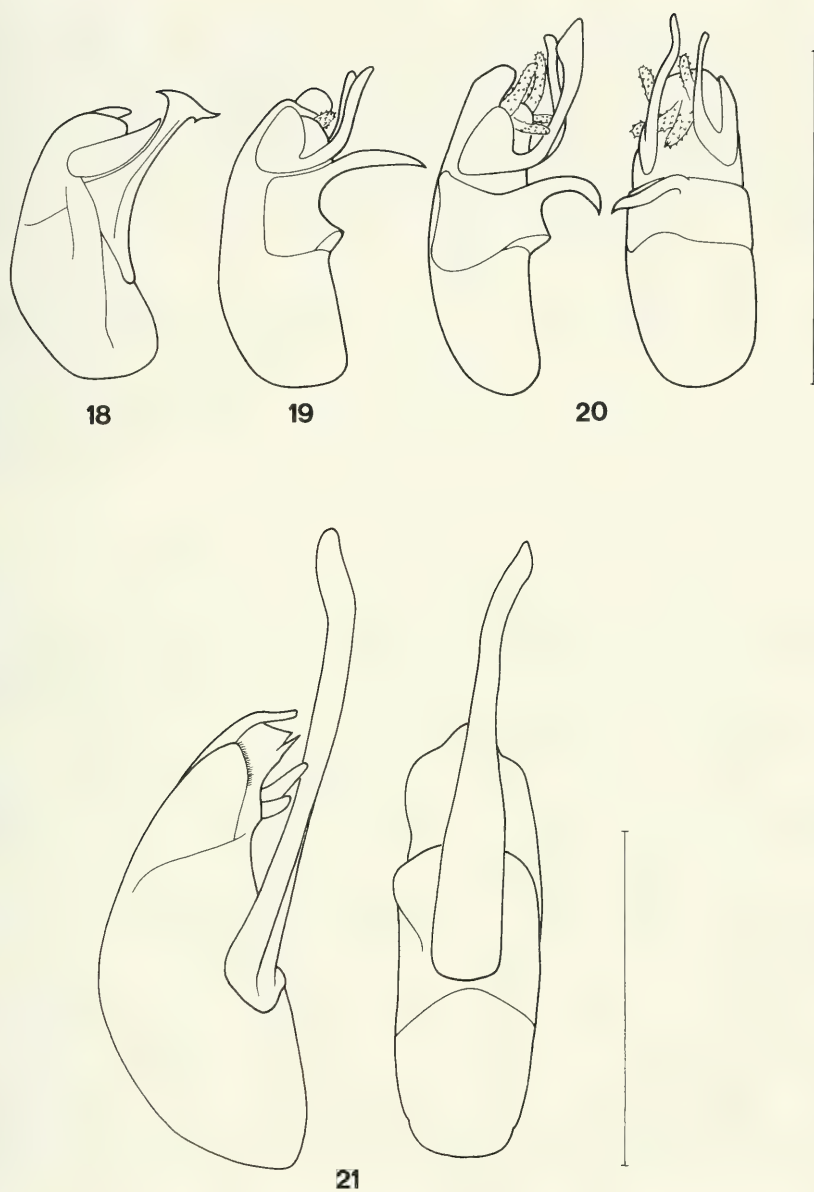
Male: Abdominal sternites as in *S. opacipennis*. Aedeagus: Fig. 31.

***Stiliderus schoedli* n. sp.**

♂ Holotype, 1 ♂ & 3 ♀♀ Paratypes: S. Sulawesi 1992, Umg. Malino (27), Ö Ujung Pandang, leg. Schödl 29.IV (Mus. Vienna, 2 Paratypes in coll. Rougemont).

Length: ca. 5 mm. Black, elytra fuscous; mouthparts, antennae and legs reddish-brown, the meso- and metatibia somewhat darker. Fore-body microsculptate as in the two preceding species, but facies different, the head sub-quadrate, transverse. Outline of fore-body: Fig. 7.

Proportions: Length of head: 80; breadth of head: 88; diameter of eye: 28; antennomeres: I: 30; II: 10; III: 15; IV: 14; V: 13; VI: 12; VII: 11; VIII: 10; IX: 10; X: 10; XI: 17. Length of pronotum: 84; breadth of pronotum: 70; length of elytron: 78; breadth of elytra: 92; metatarsomeres: I: 13; II: 9; III–V together: 23.



FIGS 18-21

Aedeagus in lateral and ventral views (scale: 1 mm): 18. *Stilicoderus formosanus* n. sp.; 19. *Stilicoderus granulifrons* Rgmt. (Nepal); 20. *Stilicoderus granulifrons* Rgmt. (Thailand); 21. *Stilicoderus plumbatus* Rgmt.

Sides of head and pronotum, humeral angles of elytra, outer faces of tibia and apices of profemora with a number of long stout black setae in addition to the normal fine pubescence (Fig. 7). Punctuation of head denser, and chevron patterned lines of granules on pronotum much coarser than in *S. opacipennis*. Microsculpture of head dense, deep, but leaving the surface lustrous, as in *opacipennis*. Microsculpture of quadrate elytra similar to the two preceding species, but large foveate punctures deeper and more numerous. Abdomen short, strongly narrowed anteriorly and posteriorly from broadest point across fifth urite.

Male: Sternite VII unmodified; sternite VIII unlike preceding species, with a small, shallow apico-median emargination, the apico-lateral angles broadly rounded, each furnished with a single long black seta. Aedeagus: Fig. 32.

This new species is readily distinguished from the other two densely microsculptate species by its transverse head, and from all other members of the *brendelli* group by the very conspicuous black setae on the head, pronotum, elytra and legs.

***Stiliderus* Motschoulsky s. str.**

***Stiliderus cardamomensis* n. sp.**

♂ Holotype: S. India, Kerala Cardamom Hills, 10 km SW Kumily, 77°07'E 09°31'N, Vallakadavu 1000 m, 24.12.1993, leg. Boukal & Kejval (Mus. Vienna). 1 ♀: India, Kerala, Cardamom H. 450–500 m, Valara Fall, 46 km SW of Munnar, Besuchet, Löbl, Mussard, 25.XI.72.

Black, mouthparts, antennae and legs dark brown. Pubescence of fore-body dark, dense, short, erect. Elytra densely granulose.

Proportions: Length: ca. 5.8 mm. Length of head: 86; breadth of head: 93; diameter of eye: 26; antennomeres: I: 32; II: 11; III: 15; IV: 13; V: 12; VI: 11; VII: 10; VIII: 10; IX: 10.5; X: 11; XI: 18; length of pronotum: 90; breadth of pronotum: 80; length of elytron: 80; breadth of elytron: 108; metatarsomeres: I: 15; II: 9; III–V: 26.

Male: Abdominal sternite VII not depressed, but with a broad, shallow apico-median emargination; sternite VIII strongly concave in apico-median 3/4, with a moderately deep ogival emargination (Fig. 16); aedeagus: Fig. 33, with very long ventral blade.

This is the sister species of *S. mussardi* Rgmt. from the Anaimalai Hills, and runs to that species in my key to *Stiliderus* (ROUGEMONT 1986e). It differs from *S. mussardi* in colour (*S. mussardi* has dark brown elytra and abdomen, and reddish-brown antennae and legs), in overall greater proportions, and in the male primary and secondary sex characters: In *S. mussardi* male sternite VII is mid-longitudinally depressed, with a narrow, acute emargination.

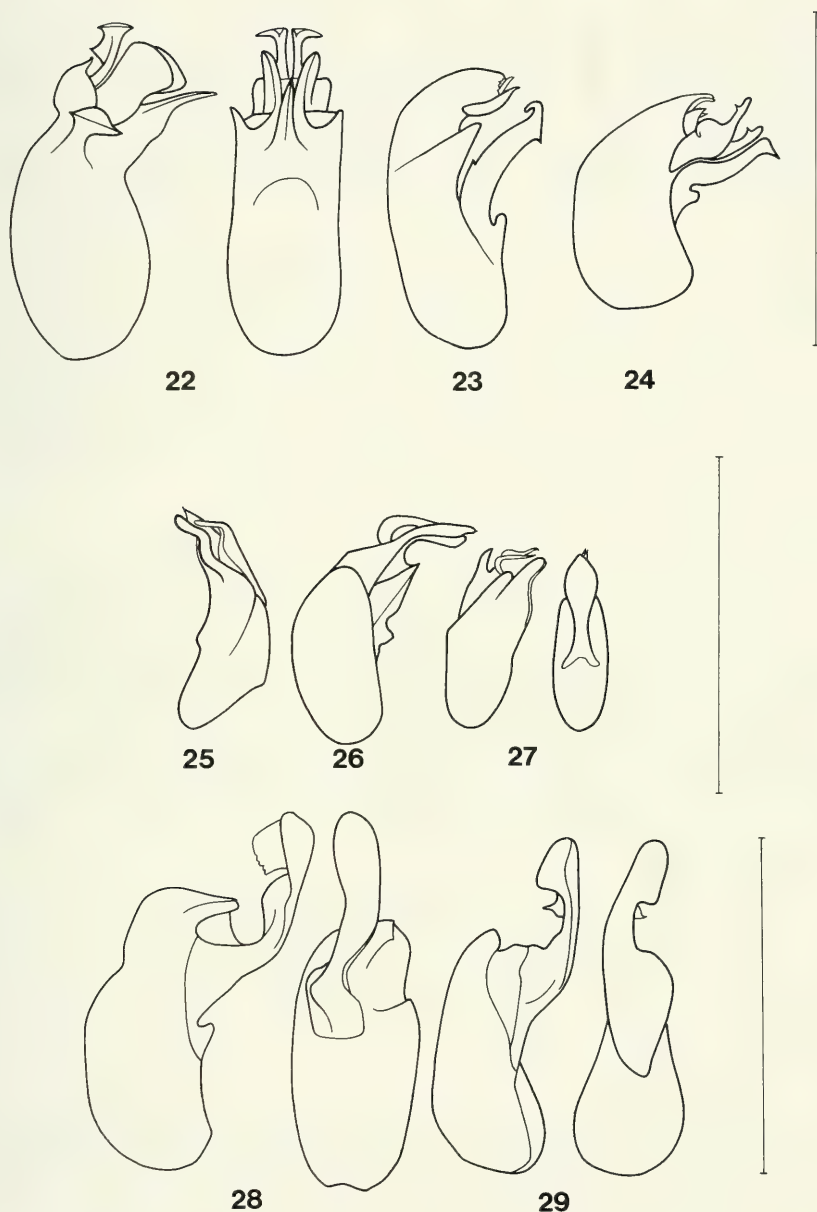
***Stiliderus crassus* (Kraatz)**

Psilotrachellus crassus Kraatz, 1859, *Arch. Naturg.* 25: 124.

Stiliderus crassus, ROUGEMONT 1986e, *Ent. Abh. Mus. Tierk. Dresden* 50, 2: 44.

1 ♂: Lombok, Pasuk Pass 300 m, forest litter, 3.XI.91, I. Löbl; 2 ♀♀: Lombok, Mt. Rinjani above Senara 900–1100 m, 5.11.1991, I. Löbl (Mus. Geneva).

The first *Stiliderus* recorded from Lombok; widely distributed in SE Asia.



FIGS 22-29

Aedeagus in lateral and ventral views (scale: 1 mm): 22. *Stilicoderus maai* Rgmt.; 23. *Stilicoderus strigosus* Rgmt. (Phetchaburi); 24. *Stilicoderus kaiensis* n. sp.; 25. *Stiliderus depressus* n. sp.; 26. *Stiliderus duplicatus* Ito; 27. *Stiliderus cottoni* n. sp.; 28. *Stiliderus kakimerah* n. sp.; 29. *Stiliderus kakihitam* n. sp.

***Stiliderus yikor* n. sp.**

♂ Holotype: Thailand, Chiang Rai, Ban Du, III.1987, G. de Rougemont; 1 ♂ Paratype: China, Yunnan, Xishuangbanna, Mengdian, 22.II.1993, G. de Rougemont (Mus. Geneva, coll. Rougemont).

Length: 5.6–5.9 mm. Facies and sculpture of *S. crassus* Kr.

Proportions: Length of head: 70; breadth of head: 83; Diameter of eye: 22; length of antenna: 133; length of pronotum: 80; breadth of pronotum: 77; length of elytron: 75; breadth of elytron: 99; metatarsus: 42.

Male: Abdominal sternite VII (Fig. 17) broadly emarginate, in the centre of emargination with a small pair of explanate lamellate processes; sternite VIII deeply concave in median area, apically with a small emargination; aedeagus: Fig. 34.

I can find no significant specific differences between this new species and *S. crassus* apart from the male primary and secondary sex characters. The head of the new species is rather less convex than that of *S. crassus*, in this approaching *S. expectatus* Rgmt., but the difference is so slight to express in terms of measurements. The male sex characters however clearly define the two species.

***Stiliderus yunnanensis* n. sp.**

♀ Holotype & 9 ♀♀ Paratypes: China, Yunnan, Ruili, 4.II.1993, G. de Rougemont (Mus. Geneva, coll. Rougemont).

Length: 5.2–5.7 mm. Black, mouthparts, antennae and legs reddish-brown. Fore-body clothed in conspicuous pale, long pubescence. Elytra not granulose. Almost indistinguishable in facies and sculpture from *S. occidentalis* Rgmt.

Proportions: Length of head: 78; breadth of head: 83; diameter of eye: 23; antennomeres: I: 23; II: 9; III: 12; IV: 11; V: 10; VI: 10; VII: 9; VIII: 8.5; IX: 8.5; X: 8; XI: 15; length of pronotum: 80; breadth of pronotum: 78; length of elytron: 73; breadth of elytra: 95; metatarsus: 45.

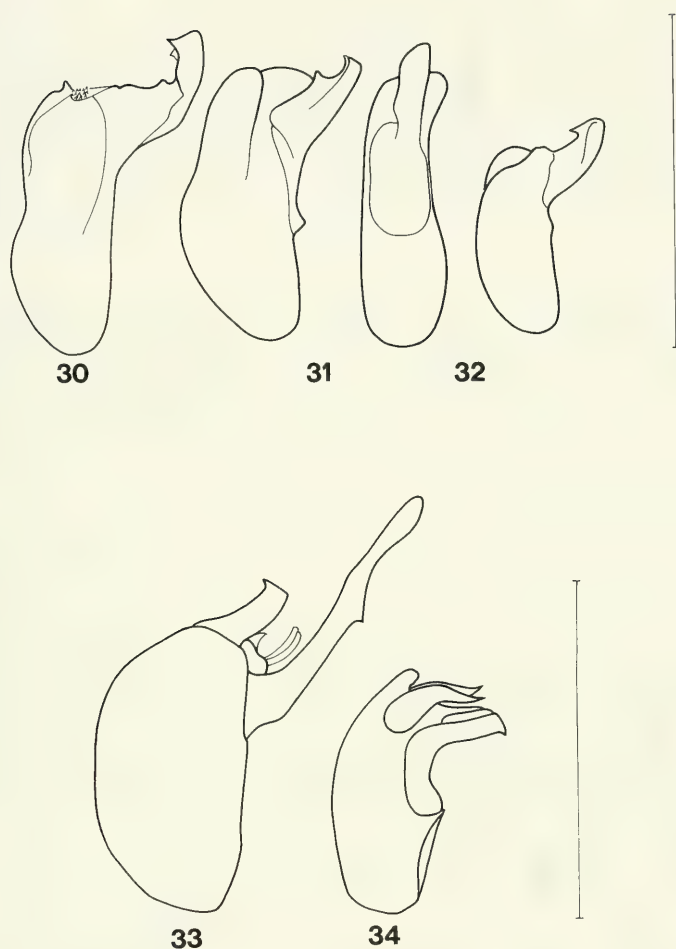
Male unknown.

This new species belongs to a sub-group of three other species (*S. occidentalis* Rgmt, *S. smetanai* Rgmt., *S. loebli* Rgmt.) characterised by the broad pronotum without basal callus, only slightly transverse head, and the male sex characters. The new species is closest to *S. occidentalis*, from which it differs by slightly sparser punctuation of head, considerably longer antennae, with segments I–VIII all elongate (segments VII & VIII transverse in *S. occidentalis*), and the sides of pronotum more strongly convergent posteriorly.

Despite the close similarity of *S. yunnanensis* n. sp. to *S. occidentalis*, and the absence of males to confirm its validity, I have no hesitation in describing it as a new species. *S. occidentalis* is confined to the western Himalaya, while the other two members of the group, which occur respectively in Nepal and NE India, are less similar to it.

***Stiliderus expectatus* Rougemont**

Stiliderus expectatus ROUGEMONT, 1986b, *Reichenbachia* 24, 4: 56; ROUGEMONT 1986e, *Ent. Abh. Mus. Tierk. Dresden* 50, 2: 45.



FIGS 30-34

Aedeagus in lateral and ventral views (scale: 1 mm): 30. *Stiliderus opacipennis* n. sp.; 31. *Stiliderus opacus* n. sp.; 32. *Stiliderus schoedli* n. sp.; 33. *Stiliderus cardamomensis* n. sp.; 34. *Stiliderus yikor* n. sp.

8 exx.: Thailand, Chiang Rai, Ban Du, III.1987, G. de Rougemont; 1 ♂: Thailand, Chaing Mai, Doi Pui, III.1987, G. de Rougemont; Thailand, Chantaburi, Khao Sabap Nat. Park, 150-300 m, 24.XI.85, Burckhardt-Löbl; Thailand, Khao Yai Nat. Park, Khao Kheo 150 m, 28.XI.85, Burckhardt-Löbl; Malaysia, Perak, Cascade Sungai Simeh, Cameron Highlands, T. Jaccoud III.77; Sabah, Poring Hot Springs 500 m, 13.V. 1987, Burckhardt-Löbl.

Hitherto only known by the Type series from Bali.

***Stiliderus cicatricosus* Motschoulsky**

Stiliderus cicatricosus Motschoulsky, 1858, *Bull. Mosc.* 31, 2: 639; ROUGEMONT 1986e, *Ent. Abh. Mus. Tierk. Dresden* 50, 2: 43.

Sumatra, Aceh no. 25a, Mt. Leuser NP, 300–500 m, Ketamba, 23–30.XI.1989, Löbl, Agosti, Burckhardt; 1 ♀: China, Yunnan, Xishuangbanna, Mengdian, 22.I.1993, G. de Rougemont; 1 ♂: China, Yunnan, Ruili, 4.II.1993, G. de Rougemont.

New to Sumatra and China.

ACKNOWLEDGMENTS

My thanks to those friends and colleagues who made most of this material available for study: M. Brendell and P. Hammond (Natural History Museum, London), T. Ito (Kyoto), I. Löbl (Geneva Museum), W. Schawaller (Stuttgart Museum), H. Schillhammer (Vienna Museum), A. Smetana (Ottawa).

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Indo-australische Anthicidae (Coleoptera) im Naturhistorischen Museum in Genf*

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Indo-Australian Anthicidae (Coleoptera) from the Natural History Museum in Geneva. - Following Tomoderini are described and illustrated: *Derarimus calamei* sp. n., *Derarimus fortepunctatus* sp. n., *Derarimus luteipes* sp. n., *Derarimus ovipennis* sp. n., *Derarimus pahangensis* sp. n., *Derarimus selangorensis* sp. n., *Tomoderus bicolor* sp. n. and *Tomoderus globicollis* sp. n..

Key-words: Coleoptera - Anthicidae - Taxonomy - Malaysia - Thailand - Indonesia - Australia.

EINLEITUNG

In einer weiteren Bestimmungssendung, die mir Herr Dr Ivan Löbl vom Naturhistorischen Museum in Genf zukommen ließ, fanden sich acht bisher unbeschriebene Arten aus den Gattungen *Derarimus* und *Tomoderus*, die nachfolgend beschrieben werden. Für die neuen *Derarimus*-Arten wird ein Schlüssel beigefügt, nach dem sie in die Bestimmungstabelle (UHMANN 1994) aufgenommen werden können.

Herrn Dr Ivan Löbl danke ich sehr für die Ausleihe der Käfer und für die Überlassung einiger Tiere für meine Sammlung.

Alle Holotypen befinden sich im Naturhistorischen Museum in Genf. Alle Maße sind in mm angegeben.

ARTENLISTE

Mecynotarsus nanus Laferté, 1848

Verbreitung: Indien, Thailand, Philippinen.

Thailand, Ban Kiriwong, Khao Luang Nat. Park, 170 m, 10.2.1991, 2 Ex., leg. P. Schwendinger.

* 53. Beitrag zur Kenntnis der Anthicidae.

Manuscript angenommen um 04.01.1996.

***Derarimus calamei* sp. n.**

(Abb. 1–4)

W.-Malaysia, Pahang, Genting Highlands, 1700 m, 2.4.1993, 2 Ex. (Holotypus, Paratypus), leg. I. Löbl und F. Calame, # 26.

Länge 4,9, größte Breite 2,1. Kopf 0,9 lang, 0,9 breit. Halsschild 1,3 lang, 0,8 breit. Flügeldecken 2,8 lang, 2,1 gemeinsam breit.

Färbung: Kopf und Halsschild rotbraun, Flügeldecken dunkelbraun mit leichtem, kupferigem Metallglanz. Beine und Taster braun. Fühler dunkelbraun, die zwei ersten und die zwei letzten Glieder wesentlich heller.

Kopf: Glänzend. Fein, ziemlich flach und verstreut punktiert. Behaarung braun, kräftig, halb abstehend, größtenteils quer liegend. Außerdem mit wenigen längeren Borsten besetzt. Fühler kräftig behaart und beborstet.

Halsschild: Glänzend. Vorn sehr fein und sehr verstreut punktiert. In der Einschnürung mit einem Längskiel in der Mitte, daneben runzelig, seitlich glatt. Hinter der Einschnürung etwas kräftiger und dichter aber flach punktiert. Behaarung braun, ziemlich fein, kurz, halb abstehend, größtenteils quer liegend, gebogen. Dazwischen stehen einige nicht sehr lange Borsten steil ab. Hals grob gekörnt. Vorn in der Mitte mit einer flachen Grube (nur bei den Männchen).

Flügeldecken: Glänzend. Punkte mittelgroß und flach. Nach hinten zu werden die Punkte nur wenig kleiner. Zwischenräume etwa 2–6mal so groß wie die Punkte. Behaarung hellbraun, kräftig, nicht sehr lang, gebogen, etwas abstehend, nach hinten gerichtet. Außerdem stehen einige nicht sehr lange, gebogene Borsten steil ab. In der Hinterhälfte, neben der Naht etwas niedergedrückt.

Beine nicht auffällig behaart.

Beziehungen: Dem *Derarimus javanus* Uhmman aus Java ähnlich, aber größer, *D. calamei* etwa 4,9 mm, *D. javanus* etwa 3,2 mm. Die Punktur in der Halsschild-Einschnürung ist bei *D. calamei* viel feiner.

Derivatio nominis: Diese Art benenne ich nach einem der beiden Entdecker, Herrn François Calame aus Genf.

***Derarimus fortepunctatus* sp. n.**

(Abb. 5 und 6)

W.-Malaysia, Pahang, Cameron Highlands, 1720 m, Gunung Jasar, # 19 b, 25.3.1993, 1 Ex. (Holotypus), 25.3.1993, leg. I. Löbl und F. Calame.

Länge 3,7, größte Breite 1,5. Kopf 0,7 lang, über die Augen gemessen 0,7 breit. Halsschild 0,9 lang, 0,7 breit. Flügeldecken 2,1 lang, 1,5 gemeinsam breit.

Färbung: Kopf dunkelbraun. Halsschild heller braun. Flügeldecken schwarz. Fühler braun mit hellerer Spitze. Taster und Beine braun.

Kopf: Glänzend. Vorn sehr fein, hinten kräftiger punktiert. Zwischenräume überall viel größer als die Punkte. Behaarung hellbraun, kräftig, ziemlich lang, etwas gebogen, abstehend, in verschiedene Richtungen weisend. Dazwischen stehen einige lange, gerade Borsten senkrecht ab. Fühler kräftig behaart und beborstet.

Halsschild: Etwas glänzend. Sehr kräftig punktiert. In der Mitte sind die Punkte verrunzelt. Im Bereich der Einschnürung oben mit einem Längskiel, davor mit

einer Vertiefung, am Hinterrand in der Mitte abgeflacht. Behaarung hellbraun, kräftig, kürzer und weniger abstechend als die des Kopfes. Dazwischen stehen einige Borsten senkrecht ab.

Flügeldecken: Glänzend. Sehr kräftig, stellenweise runzelig punktiert. Behaarung hellbraun, sehr kräftig, wenig gebogen, halb abstechend, nach hinten gerichtet. Dazwischen stehen zahlreiche lange Borsten steil ab. Neben der Naht auf der ganzen Länge niedergedrückt. Beine unauffällig behaart.

Beziehungen: Dem *Derarimus nigripennis* Uhmann aus Taiwan ähnlich, aber Halsschild auch vorn sehr kräftig punktiert.

Derivatio nominis: Der Name soll auf die kräftige Punktur auf Kopf, Halsschild und Flügeldecken hinweisen.

Derarimus foveicollis Uhmann, 1996

Verbreitung: Malaysia.

W-Malaysia, Pahang, Fraser's Hill, 1300 m, Tiong Trail, 20.3.1993, # 13, 2 Ex., leg. I. Löbl und F. Calame – W-Malaysia, Selangor, 5 km unterhalb Fraser's Hill, 1100 m, Schlucht, # 7, 15.–16.3.1993, 1 Ex. leg. I. Löbl und F. Calame.

Derarimus javanus Uhmann, 1994

Verbreitung: Java.

W-Malaysia, Pahang, Cameron Highlands, Trail 9, 1400 m, 27.3.1993, # 21, 3 Ex., leg. I. Löbl und F. Calame – W-Malaysia, Pahang, Genting Highlands, Awana, 950 m, # 28, 4.4.1993, 4 Ex., leg. I. Löbl und F. Calame. – W-Malaysia, Pahang, Taman Negara, 90–130 m, Tahan Trail, Urwald, 11.3.1993, 1 Ex., # 2 a, leg. I. Löbl und F. Calame – W-Malaysia, Pahang, Taman Negara, Tembeling Trail, 90–120 m, 10. und 13.3.1993, Urwald, # 1 a, 1 Ex., leg. I. Löbl und F. Calame.

Derarimus laticornis Uhmann, 1993

Verbreitung: Borneo.

W-Malaysia, Pahang, N. Kampong Serama, 100 m, Sekundärwald, # 3, 12.3.1993, 1 Ex. leg. I. Löbl und F. Calame – W-Malaysia, Selangor, Gap, 900 m, 14.3.1993, Sekundärwald nahe Strasse, # 4, 1 Ex. leg. I. Löbl und F. Calame.

Derarimus loebli Uhmann, 1994

Verbreitung: Sumatra.

W-Malaysia, Selangor, 5 km unterhalb Fraser's Hill, 1100 m, Schlucht, # 7, 15.–16.3.1993, 3 Ex., leg. I. Löbl und F. Calame — W-Malaysia, Selangor, Gap, 900 m, 14.3.1993, # 4, Sekundärwald nahe Strasse, 1 Ex., leg. I. Löbl und F. Calame — W-Malaysia, Pahang, Taman Negara, Tembeling Trail, 90–120 m, Urwald, # 1 a, 1 Ex., leg. I. Löbl und F. Calame.

Derarimus luteipes sp. n.

(Abb. 7 und 8)

W-Malaysia, Pahang, N. Kampong Serama, 100 m, Sekundärwald, # 3, 12.3.1993, 1 Ex., leg. I. Löbl und F. Calame (Holotypus) – W-Malaysia, Selangor, Gap, 900 m, 14.3.1993, Sekundärwald nahe Strasse, # 4, 3 Ex., leg. I. Löbl und F. Calame, (Paratypen).

Länge 3,1, größte Breite 1,2. Kopf 0,8 lang, über die Augen gemessen 0,8 breit. Halsschild 0,8 lang, 0,6 breit. Flügeldecken 1,6 lang, 1,2 gemeinsam breit.

Färbung: Kastanienbraun, Flügeldecken geringfügig dunkler. Fühler braun, Taster und Beine bräunlichgelb.

Kopf: Glänzend. Äußerst fein und verstreut punktiert. Behaarung hellbraun, ziemlich kräftig, etwas gebogen, steil abstehend. Dazwischen stehen einige Borsten fast gerade und steil ab. Fühler kräftig behaart und beborstet. Die Haare stehen ziemlich dicht.

Halsschild: Glänzend. Sehr fein und verstreut punktiert. In der Einschnürung sind die Punkte kräftig und genabelt, dahinter wieder fein. Vor der Einschnürung mit seichter Mittelfurche. Behaarung hellbraun, kräftig, ziemlich lang, etwas gebogen, steil abstehend. Dazwischen stehen einige Borsten fast gerade und sehr steil ab.

Flügeldecken: Glänzend. Sehr kräftig aber flach genabelt punktiert. Die Punkte werden zur Spitze kaum feiner. Behaarung hellbraun, kräftig, lang, fast gerade, halb abstehend, nach hinten gerichtet. Zahlreiche lange, gerade Borsten stehen senkrecht ab.

Beine: Behaarung ziemlich kurz und kräftig.

Beziehungen: Durch die eckigen Schultern dem *Derarimus humerifer* Uhmman aus Tonkin etwas ähnlich, aber kleiner, Halsschild in der Einschnürung kräftig punktiert.

Derivatio nominis: Der Name soll auf die hellen Beine hinweisen.

***Derarimus ovipennis* sp. n.**

(Abb. 9 und 10)

W-Malaysia, Pahang, Cameron Highlands, 1550 m, Gunung Jasar, Trail 11, # 18 b, 24.3.1993, 1 Ex., leg. I. Löbl und F. Calame, (Holotypus).

Länge 3,4, größte Breite 1,4. Kopf 0,6 lang, über die Augen gemessen 0,7 breit. Halsschild 0,8 lang, 0,6 breit. Flügeldecken 2,0 lang, 1,4 gemeinsam breit.

Färbung: Dunkelbraun. Fühler braun, die letzten vier Glieder heller. Taster und Beine hellbraun.

Kopf: Glänzend. Äußerst fein und verstreut punktiert. Behaarung braun, kräftig, ziemlich lang, schütter, etwas gebogen, etwas abstehend, in verschiedene Richtungen weisend. Mit einer flachen Längsrinne in der Mitte. Fühler kräftig behaart, die letzten vier Glieder durch die dichtere Behaarung matter.

Halsschild: Glänzend. Sehr fein und verstreut punktiert. In der Einschnürung kräftig und dicht punktiert. Behaarung braun, sehr kräftig, gebogen abstehend. Vorn mit flacher Mittelrinne, vor dem Schildchen etwas niedergedrückt.

Flügeldecken: Glänzend. Kräftig punktiert. Zwischenräume etwa so groß wie die Punkte. Zur Spitze werden die Punkte kaum feiner, die Zwischenräume kaum größer. Behaarung braun, kräftig, lang, kaum gebogen, etwas abstehend, nach hinten gerichtet. Dazwischen stehen zahlreiche gerade, nicht sehr lange Borsten steil ab.

Beine kräftig behaart.

Beziehungen: Dem *Derarimus schwendingeri* Uhmman aus Thailand etwas ähnlich aber kleiner.

Derivatio nominis: Der Name soll auf die eiförmigen Flügeldecken hinweisen.

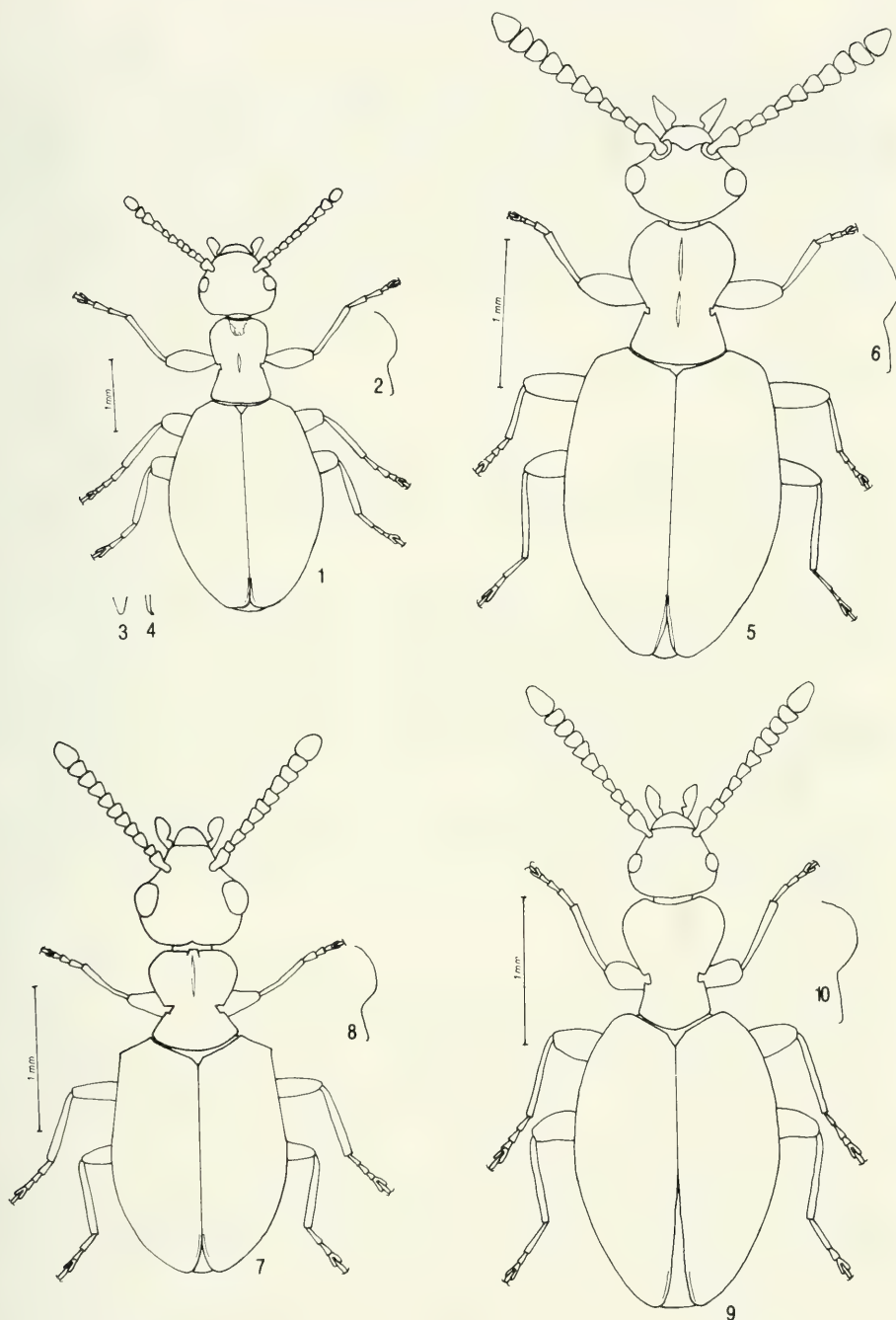


ABB. 1-10. - 1. *Derarimus calamei* sp. n. Habitus; 2. *Derarimus calamei* sp. n. Halsschildprofil; 3. *Derarimus calamei* sp. n. Aedeagus dorsal; 4. *Derarimus calamei* sp. n. Aedeagus lateral; 5. *Derarimus fortepunctatus* sp. n., Habitus; 6. *Derarimus fortepunctatus* sp. n., Halsschildprofil; 7. *Derarimus luteipes* sp. n., Habitus; 8. *Derarimus luteipes* sp. n., Halsschildprofil; 9. *Derarimus ovipennis* sp. n., Habitus; 10. *Derarimus ovipennis* sp. n. Halsschildprofil.

Derarimus pahangensis sp. n.

(Abb. 11 und 12)

W-Malaysia, Pahang, Cameron Highlands, Trail 9, 1400 m, 27.3.1993, # 21, 5 Ex., leg. I. Löbl und F. Calame (Holotypus, 4 Paratypen) – W-Malaysia, Selangor, 5 km unterhalb Fraser's Hill, 1100 m, Schlucht, # 7, 15.–16.3.1993, 1 Ex., leg. I. Löbl und F. Calame (Paratypus) – W-Malaysia, Pahang, Fraser's Hill, 1300 m, Tiong Trail, 20.3.1993, # 13, 3 Ex., leg. I. Löbl und F. Calame (Paratypen) – W-Malaysia, Pahang, Ringlet, 1250 m, Schlucht, # 20, 26.3.1993, 4 Ex., leg. I. Löbl und F. Calame (Paratypen) – W-Malaysia, Selangor, 1 km unterhalb Fraser's Hill, 1280 m, Sekundärwald, # 4, 15.3.1993, 1 Ex., leg. I. Löbl und F. Calame (Paratypus) – W-Malaysia, Selangor, 3 km unterhalb Fraser's Hill, 1200 m, Sekundärwald, # 6, 15.3.1993, 1 Ex., leg. I. Löbl und F. Calame (Paratypus).

Länge 2,2, größte Breite 1,0. Kopf 0,4 lang, 0,4 breit. Halsschild 0,6 lang, 0,4 breit. Flügeldecken 1,2 lang, 1,0 gemeinsam breit.

Färbung: Hellbraun. Fühler gelbbraun mit etwas dunklerer Mitte. Taster und Beine gelbbraun.

Kopf: Sehr glänzend. Äußerst fein und sehr verstreut punktiert. Behaarung hellbraun, mittelkräftig, ziemlich lang, wenig gebogen, fast senkrecht abstehend. Fühler, besonders die letzten drei Glieder, dicht behaart und kräftig beborstet. Die drei letzten Glieder matt.

Halsschild: Glänzend. Sehr fein punktiert, nur in der Einschnürung kräftiger und runzelig. Behaarung gelblich, lang, nicht sehr kräftig, wenig gebogen, halb abstehend. Dazwischen stehen einzelne längere, gerade Borsten.

Flügeldecken: Glänzend. Punkte ziemlich groß aber sehr flach. Behaarung gelblich, ziemlich lang, ziemlich dicht, fast gerade, halb abstehend, nicht sehr kräftig. Einige Borsten stehen etwas steiler ab, sie sind wenig länger als die Grundbehaarung.

Beine kräftig behaart.

Beziehungen: Durch die geringe Größe dem *Derarimus minutissimus* Uhmann von Java ähnlich, aber die Flügeldecken sind seitlich stark konvex, bei *D. minutissimus* fast parallelseitig.

Derarimus selangorensis sp. n.

(Abb. 13 und 14)

W-Malaysia, Selangor, 3 km unterhalb Fraser's Hill, 1200 m, Sekundärwald, # 6, 13.3.1993, 2 Ex., leg. I. Löbl und F. Calame (Holotypus, Paratypus).

Länge 3,6, größte Breite 1,3. Kopf 0,6 lang, über die Augen gemessen 0,8 breit. Halsschild 0,9 lang, 0,7 breit. Flügeldecken 2,1 lang, 1,3 gemeinsam breit.

Färbung: Kopf dunkelbraun, Halsschild heller braun, Flügeldecken sehr dunkel braun. Fühler braun mit hellerer Spitze. Taster und Beine hellbraun.

Kopf: Glänzend. Äußerst fein und sehr verstreut punktiert. Behaarung braun, sehr kräftig, gebogen, halb abstehend, in verschiedene Richtungen weisend. Wenige gerade, lange Borsten stehen senkrecht ab. Fühler kräftig behaart und beborstet, die letzten vier Glieder matt.

Halsschild: Glänzend. Äußerst fein, nur in der Abschnürung sehr kräftig und runzelig punktiert. Behaarung braun, kräftig, gebogen, sehr abstehend. Einige lange, gerade Borsten stehen senkrecht ab. Am Vorderrand in der Mitte mit einer Ausbuchtung (nur bei den Männchen?), dahinter mit einer Vertiefung, die bis zur Einschnürung reicht. Vor dem Schildchen abgeflacht.

Flügeldecken: Glänzend. Grob punktiert. Zur Spitze wird die Punktur wenig feiner, aber etwas flacher. Zwischenräume meist viel kleiner als die Punkte. Behaarung braun, kräftig, lang, fast gerade, nach hinten gerichtet. Dazwischen stehen zahlreiche sehr kräftige Borsten fast gerade, sehr steil ab. In der hinteren Hälfte neben der Naht etwas niedergedrückt.

Beine ziemlich dicht aber kurz behaart.

Beziehungen: Dem *Derarimus nigripennis* Uhmann aus Taiwan etwas ähnlich, aber der Kopf ist viel breiter, die Augen sind viel größer.

Tomoderus bicolor sp. n.

(Abb. 15 und 16)

W-Malaysia, Selangor, 1 km unterhalb Fraser's Hill, 1280 m, Sekundärwald, # 5, 15.3.1993, 1 Ex., leg. I. Löbl und F. Calame (Holotypus).

Länge 4,1, größte Breite 1,6. Kopf 0,8 lang, über die Augen gemessen 0,9 breit. Halsschild 1,1 lang, 0,6 breit. Flügeldecken 2,3 lang, 1,6 gemeinsam breit.

Färbung: Kopf und Halsschild kastanienbraun, Flügeldecken schwarzbraun. Taster, Fühler und Beine braun.

Kopf: Glänzend. Sehr fein und verstreut punktiert. Behaarung hellbraun, kräftig, nicht sehr lang, gebogen, halb abstechend. Dazwischen stehen zahlreiche lange, fast gerade Borsten senkrecht ab. Einzelne Borsten sind auch gebogen. Fühler kräftig und ziemlich dicht behaart, die letzten drei Glieder sind matt.

Halsschild: Glänzend. Fein und verstreut punktiert. In der Einschnürung grob gerunzelt. Behaarung hellbraun, kräftig, gebogen, halb abstechend, in verschiedene Richtungen weisend. Außerdem stehen zahlreiche lange, kräftige Borsten steil ab.

Flügeldecken: Glänzend. Grob, zum Teil genabelt punktiert. Die Punkte werden zur Spitze nur wenig feiner. Zwischenräume teils kleiner als die Punkte, teils bis etwa 2mal so groß wie die Punkte. Behaarung braun, kräftig, lang, wenig gebogen, halb abstechend, nach hinten gerichtet. Dazwischen stehen zahlreiche lange Borsten sehr steil ab.

Beine unauffällig behaart.

Beziehungen: Durch die Färbung und durch die Größe dem *Derarimus nigripennis* Uhmann aus Taiwan etwas ähnlich. Es fehlt aber die seitliche Einkerbung am Halsschild (Gattungsmerkmal von *Derarimus*). Der Halsschild ist sanduhrförmig.

Tomoderus burmanus Heberdey, 1936

Verbreitung: Burma, Assam, Thailand.

Thailand, Loei Prov., Phu Rua Nat. Park, 5.9.1992, 1 Ex., leg. P. Schwendinger – W-Malaysia, Pahang, Batu Caves N. Kuala Lumpur, 31.3.1993, # 24, 1 Ex., leg. I. Löbl und F. Calame – W-Malaysia, Pahang, Ringlet, 1250 m, Schlucht, # 20, 26.3.1993, 1 Ex., leg. I. Löbl und F. Calame – W-Malaysia, Fraser's Hill, 1050 m, Jeriau Wasserfälle, # 12 a, 19.3.1993, 1 Ex., leg. I. Löbl und F. Calame.

Tomoderus coomani Pic, 1926

Verbreitung: Tonkin, Thailand, Vietnam.

Thailand, Phu Hin Rongkla Nat. Park, 1200 m, 12.9.1990, 1 Ex., leg. P. Schwendinger.

Tomoderus globicollis sp. n.

(Abb. 17 und 18)

Thailand, Phu Hin Rongkla Nat. Park, 1200 m, 12.9.1990, 1 Ex., leg. P. Schwendinger (Holotypus).

Länge 2,3, größte Breite 1,0. Kopf 0,5 lang, über die Augen gemessen 0,4 breit. Halsschild 0,6 lang, 0,4 breit. Flügeldecken 1,2 lang, 1,0 gemeinsam breit.

Färbung: Braun. Taster, Fühler und Beine hellbraun.

Kopf: Glänzend. Äußerst fein und verstreut punktiert. Behaarung gelbbraun, mittelmäßig in Stärke und Länge, gebogen, fast ganz absteehend. Dazwischen stehen zahlreich nicht sehr lange Borsten senkrecht ab.

Halsschild: Glänzend. Sehr fein und verstreut punktiert, nur in der Einschnürung kräftig gerunzelt. Behaarung gelbbraun, mittelmäßig, gebogen, fast ganz absteehend. Dazwischen stehen zahlreiche lange, nicht sehr kräftige Borsten gerade und senkrecht ab.

Flügeldecken: Glänzend. Sehr stark punktiert, Zwischenräume kleiner als die Punkte. Zur Spitze werden die Punkte etwas feiner, die Zwischentäume etwa 1 bis 3mal so groß wie die Punkte. Behaarung gelbbraun, ziemlich lang, nicht sehr kräftig, etwas gebogen, halb absteehend. Dazwischen stehen zahlreiche lange, nicht sehr kräftige Borsten steil ab.

Beine nicht sehr auffällig behaart.

Beziehungen: Dem *Tomoderus promiscuus* Krekich von den Philippinen und dem *T. sulcifer* Pic aus Java und Sumatra etwas ähnlich, aber die Fühler sind kräftiger, der Kopf ist breiter, die Flügeldecken sind bauchiger. Von *T. binodulus* Uhmman von Borneo unterscheidet er sich durch kräftigere Fühler, geringere Körpergröße und durch vorn breiteren Halsschild.

Tomoderus plicicollis Pic, 1901

Verbreitung: Neuguinea, Australien.

Austr., Queensland, Cape Tribulation National Park, Pilgrim Sands, 26.7.–3.8.1986, 3 Ex., leg. S. Kiener.

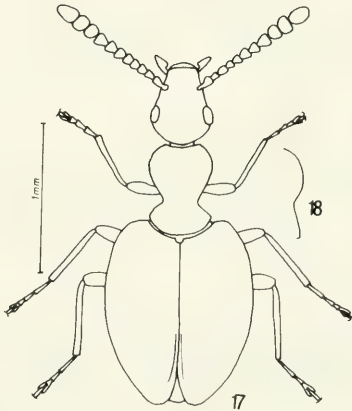
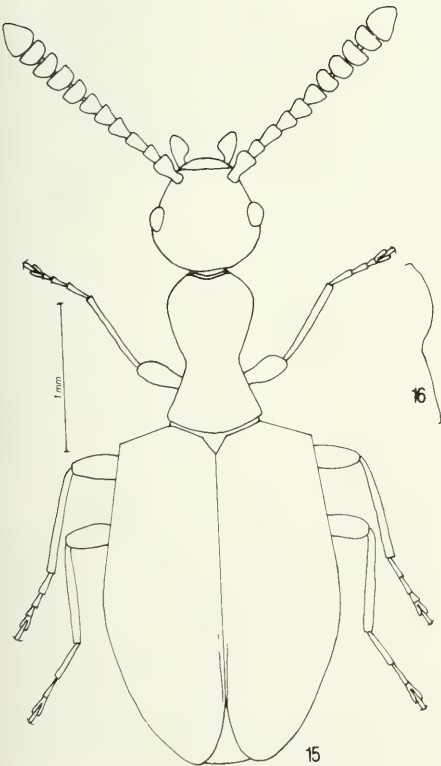
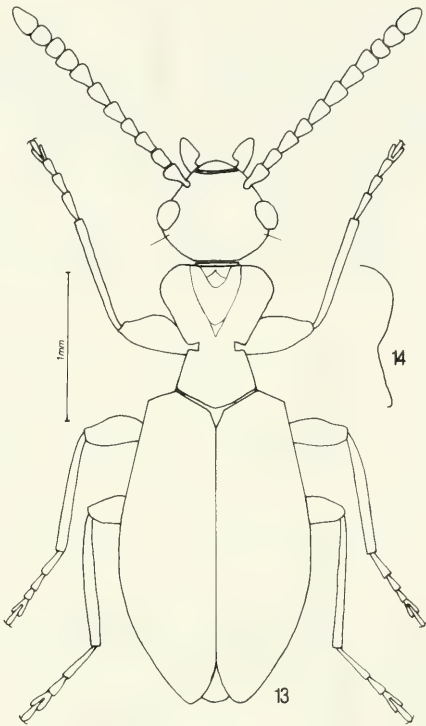
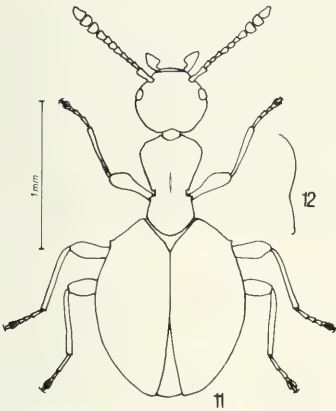
Tomoderus promiscuus Krekich, 1929

Verbreitung: Philippinen, Borneo, Sulawesi.

Indonesia, Sulawesi, Sel. W of Manasa, 1600 m, 9.4.1991, leg. D. Agosti, 4 Ex.

 ABB. 11-18

11. *Derarimus pahangensis* sp. n., Habitus; 12. *Derarimus pahangensis* sp. n., Halsschildprofil; 13. *Derarimus selangorensis* sp. n., Habitus; 14. *Derarimus selangorensis* sp. n., Halsschildprofil; 15. *Tomoderus bicolor* sp. n., Habitus; 16. *Tomoderus bicolor* sp. n., Halsschildprofil; 17. *Tomoderus globicollis* sp. n., Habitus; 18. *Tomoderus globicollis* sp. n., Halsschildprofil.



Tomoderus schuhi Uhmman, 1996

Verbreitung: Malaysia.

W-Malaysia, Pahang, Cameron Highlands, Trail 9, 1400 m, 27.3.1993, # 21, 2 Ex., leg. I. Löbl und F. Calame – W-Malaysia, Pahang, Ringle, 1250 m, Schlucht, # 20, 26.3.1993, 1 Ex., leg. I. Löbl und F. Calame – W-Malaysia, Pahang, Fraser's Hill, 1300 m, Tiong Trail, # 13, 20.3.1993, 4 Ex., leg. I. Löbl und F. Calame – W-Malaysia, Pahang, Taman Negara, 90–120 m, Tembeling Trail, Urwald, # 1 a, 10 und 13.3.1993, 1 Ex., leg. I. Löbl und F. Calame – W-Malaysia, Pahang, Fraser's Hill, 1050 m, Jerian Wasserfälle, # 12 a, 19.3.1993, 1 Ex., leg. I. Löbl und F. Calame – W-Malaysia, Selangor, Gap, 900 m, 14.3.1993, Sekundärwald nahe Strasse, 1 Ex., leg. I. Löbl und F. Calame – W-Malaysia, Selangor, 5 km unterhalb Fraser's Hill, 1100 m, Schlucht, # 7, 13.–16.3.1993, 2 Ex., leg. I. Löbl und F. Calame.

Tomoderus subcostulatus Pic, 1901

Verbreitung: Sumatra.

W-Malaysia, Pahang, Genting Highlands, Awana, 1150 m, 3.4.1993, # 27 a, 1 Ex., leg. I. Löbl und F. Calame.

Tomoderus unifasciatus Pic, 1907

Verbreitung: Indien, Thailand, Burma.

Thailand, Taksin Maharat N.P., 1000 m, 9.2.1993, 1 Ex., leg. P. Schwendinger – Thailand, Chiang Mai Prov., Doi Suthep, 1200 m, 9.11.1991, 3 Ex., leg. P. Schwendinger – Thailand, Prachuab Kiri Khan Prov., Huay Yang N. Park, 670 m, 29.11.1991, 4 Ex., leg. P. Schwendinger – Thailand, Lamphun Province, 1000 m, Doi Khuntan N. Park, 25.9.1991, 3 Ex., leg. P. Schwendinger – Thailand, Loel Prov., Phu Rua Nat. Park, 1080–1250 m, 3.9.1992, 1 Ex., leg. P. Schwendinger – Thailand, Ban Maeo Microwave, Mae Hong Son Dist., 1250 m, 15.12.1990, 1 Ex., leg. P. Schwendinger – Thailand, Lamphun Prov., Doi Khuntan N.P., 1100 m, 8.10.1992, 1 Ex., leg. P. Schwendinger.

Formicomus armatus Boheman, 1858

Verbreitung: Indien, Thailand, Vietnam, Japan, Java, Sumatra, Malaysia, Sri Lanka, Philippinen, China.

Thailand, Mts. N. Umphang, Mae Sot Umphang, 1250 m, 10.2.1993, 2 Ex., leg. P. Schwendinger.

Formicomus conjugatus Krekich, 1926

Verbreitung: Annam, Thailand.

Thailand, Mts. N. Umphang, Mae Sot Umphang, 1250 m, 10.2.1993, 1 Ex., leg. P. Schwendinger.

Formicomus longispinus Pic, 1912

Verbreitung: Taiwan, Yunnan, Thailand.

Thailand, Chiang Mai Prov., Mae Hia, 350 m, 18.1.1992, 3 Ex., leg. P. Schwendinger.

***Anthicomorphus siamensis* Krekich, 1926**

Verbreitung: Thailand, Burma, Vietnam.

Thailand, Sur at Thani P., Khao Sok N. Park, 70 m, 6.12.1991, 2 Ex., leg. P. Schwendinger.

***Pseudoleptaleus sculptus* Krekich, 1926**

Verbreitung: Indien, Thailand.

Thailand, Huay ya mae Khi, Umphang dist., 670 m, 10.2.1993, 2 Ex., leg. P. Schwendinger.

***Omonadus formicarius* (Goeze, 1777)**

Verbreitung: Kosmopolit.

Thailand, Huay Yang Nat. Park, Huay Yang Waterfall, Thap Sake Dist., 50 m, 12.2.1991, 1 Ex., leg. P. Schwendinger.

***Clavicomus cordatus* (Kreich, 1931)**

Verbreitung: Indien, Nepal, Thailand.

Thailand, Tak Prov. Doi Musoe, 950 m, 18.9.1990, 1 Ex., leg. P. Schwendinger.

***Sapintus breviceps* (Laferté, 1848)**

Verbreitung: Burma, Thailand, Pakistan.

Thailand, Ban Kiriwong, Khao Luang, Nat. Park, 170 m, 10.2.1991, 4 Ex., leg. P. Schwendinger.

***Sapintus immaturus* (Laferté, 1848)**

Verbreitung: Indien, Thailand, Bangla Desh.

Thailand, Phrae Province, 560 m, Mae Khaem Waterfall, 21.9.1991, 1 Ex., leg. P. Schwendinger.

***Sapintus javanus* (Marseul, 1882)**

Verbreitung: Malaysia, Indonesien, Thailand, Vietnam, Sri Lanka, Indien.

Thailand, Ban Maeo Microwave, Mae Hong Son Dist., 1250 m, 15.12.1990, 2 Ex., leg. P. Schwendinger.

***Sapintus siamensis* (Pic, 1914)**

Verbreitung: Thailand, Vietnam.

Thailand, Banglang Nat. Park, Than To Waterfall, Than To Dist., 150 m, 1.2.1991, 2 Ex., leg. P. Schwendinger — Thailand, Ban Kiriwong, Khao Luang Nat. Park, 170 m, 10.2.1991, 1 Ex., leg. P. Schwendinger.

ERGÄNZUNG DES BESTIMMUNGS-SCHLÜSSELS FÜR DIE *derarimus*-ARTEN

- 1 Etwa 2 mm lang 1a
 1a Flügeldecken seitlich schwach konvex *minutissimus* Uhmann
 – Flügeldecken seitlich stark konvex *pahangensis* sp. n.
 8 Kopf breiter als lang, hinter den Augen sofort stark verengt 8a
 8a Größer (ca 3.8), Halsschild in der Einschnürung ziemlich fein gerunzelt
 *humifer* Uhmann
 – Kleiner (ca 3), Halsschild in der Einschnürung kräftig punktiert . *luteipes* sp. n.
 15
 – Flügeldecken nicht kräftig punktiert, mit großen Zwischenräumen 15a
 15a Etwa 3,4 mm, Malaysia *ovipennis* sp. n.
 – Etwa 4 mm, Thailand *schwendingeri* Uhmann
 26 Kopf und Halsschild braun, Flügeldecken schwarzbraun 26a
 – Anders 27
 26a Kopf so lang wie breit, Schultern weniger markant 26b
 – Kopf breiter als lang, Schultern sehr markant *selangorensis* sp. n.
 26b Halsschild vorn fein punktiert *nigripennis* Uhmann
 – Halsschild bis vorn kräftig punktiert *fortepunctatus* sp. n.
 30 Hinterkopf konkav 30a
 30a Etwa 3,2 mm *javanus* Uhmann
 – Etwa 4,9 mm *calamei* sp. n.

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Further data on the Nicolettidae (Zygentoma), with description of a new species from Mauritius

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Further data on the Nicolettidae (Zygentoma), with description of a new species from Mauritius. - *Lepidospora* (L.) *mascareniensis* sp. n. is described from Mauritius. New data are reported on *Coletinia mendesi* Wygodzinsky in Portugal, and *C. maggii* (Grassi) is recorded for the first time from France.

Key-words: Nicolettidae - Mauritius - Europe - New species - New data.

INTRODUCTION

The present paper deals with the study of one new species of *Lepidospora* s. s. (Nicoletiidae) collected in Mauritius Island and with a few samples of another genus of the same family, *Coletinia*, from Portugal and France. *L. (L.) mascareniensis* sp. n. is the first thysanuran recorded from Mauritius.

The material is deposited in the following collections: Centro de Zoologia of the Instituto de Investigação Científica Tropical, Lisboa, Portugal (CZ); Muséum d'histoire naturelle, Geneva, Switzerland (MHNG) and Muséum National d'Histoire Naturelle, Paris, France (MNHN).

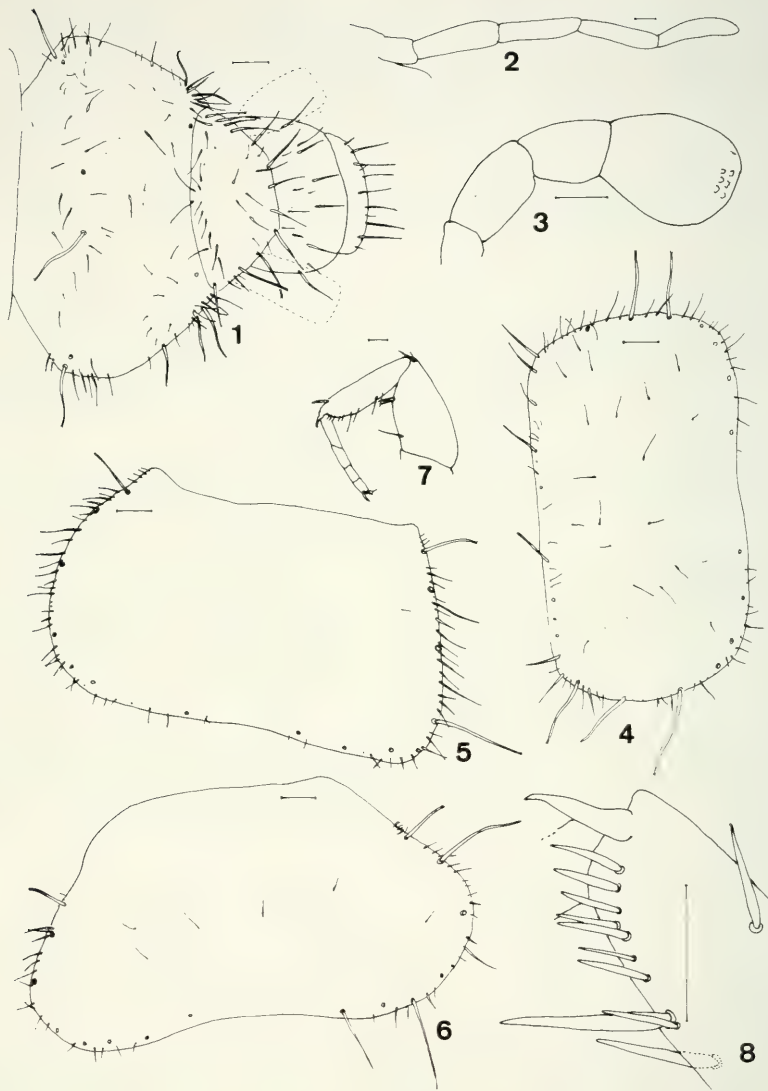
***Lepidospora* (L.) *mascareniensis* sp. n.**

Material examined: Ile Maurice — Trois Cavernes, near Cascavelle, 6–8/XI/1994, 1 ♀ holotype, leg. P. Strinati (MHNG).

Body length: 5.8 mm; thorax length: 1.9 mm; thorax width: 1.4 mm; antennae (damaged): 3.5 mm.

Body elongated, more or less parallel-sided. Hypodermal pigment absent, the general colour whitish. Macrochaetae light brown, the stronger ones apically biphid. Scales typical, with a moderate number of thin rays.

Head as in Fig. 1, with some strong elongated macrochaetae, the scales restricted to the posterior half of the cephalic capsule. Antennae typical, not completely preserved.



FIGS 1-8

Lepidospora (L.) mascareniensis sp. n. ♀ Fig. 1 – Head, dorsal view; Fig. 2 – Maxillary palp; Fig. 3 – Labial palp; Fig. 4 – Pronotum; Fig. 5 – Mesonotum; Fig. 6 – Metanotum; Fig. 7 – P I; Fig. 8 – Ibid., detail of the apical tibia chaetotaxy. Scales: 0.1 mm.

Mandibles strongly sclerotized, with several acute teeth. Maxillae without special features, the galea with two well developed cylindrical apical conules. Maxillary palp as in Fig. 2, with some quite strong and elongated macrochaetae in the basal articles; distal article 4–5 times longer than wide, its length similar to that of the preceeding one. Labium typical, with a few scattered setae, the labial palp with its apical article not much longer than wide, as in Fig. 3.

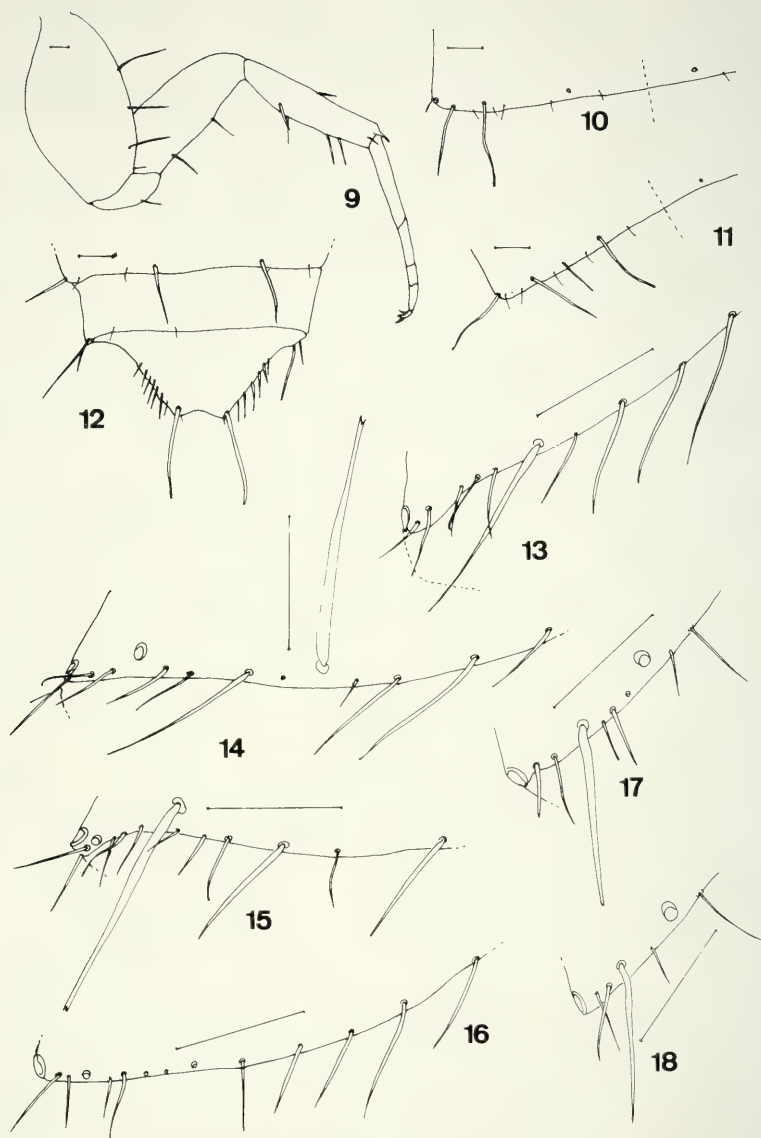
Nota with the hind border almost straight to not deeply excavated (Figs 4–6) with some strong lateral and posterolateral macrochaetae, the disc with scales and with a few scattered thin and acute setae, which are more numerous in the pronotum. Legs delicate, the outer surface of tibia I (Figs 7 and 8) with a row of distal and distal ventral spines; ventral spiniform setae robust, those of tibia I long, similar to the tibial diameter, the tibia about 3 times longer than wide; P III (Fig. 9) longer than P I, the tibia more than 4 times longer than wide. Praetarsus typical and complete, the lateral claws well developed in all pairs, smooth, the empodium smaller and clearly spinulated.

Urotergites scally, the I–VI in the dorsal surface of body with 1 + 1 submedian, 1 + 1 sublateral, 1 + 1 lateral and 1 + 1 infralateral macrochaetae and a few isolate hind marginal setae (Fig. 10). In the VIIth urotergite, the sublateral macrochaetae are clearly shorter and more delicate than the remaining ones as in Fig. 11; in the VIIIth urotergite the submedian and the infralateral macrochaetae are the only ones present (Fig. 12), and in the IXth urotergite, all the macrochaetae are missing, with the exception of those of the infralateral pair – these ones, are accompanied by one inner long and thin spiniform seta – as in Fig. 12; Xth urotergite (same figure) wide and not specially shortened, its distal margin poorly emarginated and not angulous, the distance between the strong elongated posterolateral macrochaetae similar to half their own length; lateral margins with a row of 6–7 strong short setae; in the inner area of the posterolateral macrochaetae, close to them, 1 + 1 short and delicate spinule. Ventral area of the urotergites with thin setae, cilia and one or two macrochaetae (sometimes visible only by their insertions) as in Figs 13–19.

Urosternite I typical, subdivided in one triangular sternite and 1 + 1 wide lateral coxites, almost devoided of setae. Urosternites II–VI as in Fig. 20, with 1 + 1 anterior and 1 + 1 posterior submedian macrochaetae besides the marginal short setae; in the Vth urosternite (abnormal) the right stylet is missing and replaced by a series of thin setae, as in Fig. 21. Subgenital plate very short and widely parabolic, as in Fig. 22. As typical, stylets present in the urosternites II–IX, fusiform, the most posterior with a few very strong spines, the vesicles in the urosternites II–VII (the VIIth with reduced pseudovesicles). Ovipositor strong and fusiform (Fig. 23), extending beyond the level of the IXth stylets by about 2/3–3/4 of their own length. Gonapophyses with 14–15 articles, provided with thin setae only, the anterior pair stronger, their distal articles as in Figs 24 and 25.

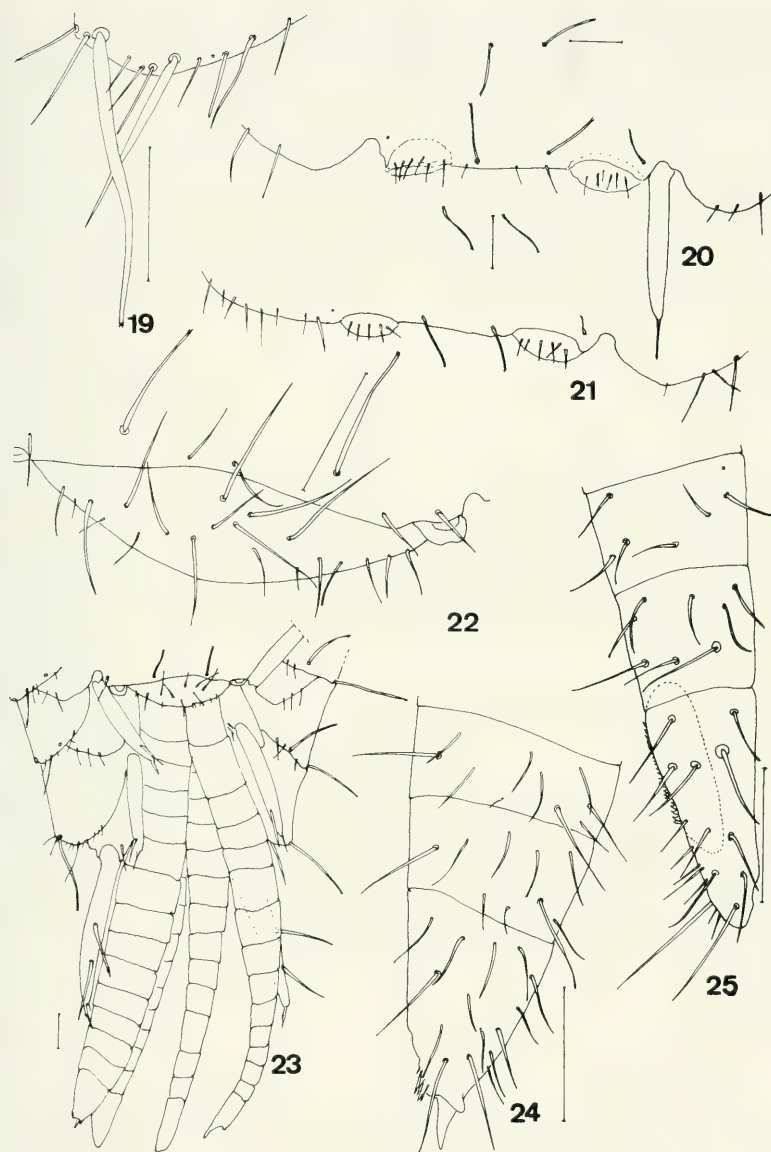
Cerci and terminal filament typical, with very strong and elongated macrochaetae, apically damaged.

Derivatio nominis: Dedicated to D. Pedro de Mascarenhas, who discovered the island of Reunion (one of the Mascarene Islands, like Mauritius) in 1505.



FIGS 9-18

Lepidospora (L.) mascareniensis sp. n. ♀ Fig. 9 – P III; Fig. 10 – Vth urotergite; Fig. 11 – VIIth urotergite; Fig. 12 – IXth and Xth urotergites; Fig. 13 – Infralateral chaetotaxy of IIIrd urotergite; Fig. 14 – Ibid. of urotergite IV; Fig. 15 – Ibid. of urotergite V; Fig. 16 – Ibid. of urotergite VI; Fig. 17 – Ibid. of urotergite VII; Fig. 18 – Ibid. of urotergite VIII. Scales: 0.1 mm.



FIGS 19-25

Lepidospora (L.) mascareniensis sp. n. ♀ Fig. 19 – Infralateral chaetotaxy of IXth urotergite; Fig. 20 – IIIrd urosternite; Fig. 21 – Vth anomalous urosternite (the right stylet is lacking); Fig. 22 – Posterior border of VIIth urosternite and subgenital plate; Fig. 23 – Ventral posterior area of abdomen; Fig. 24 – VIIIth gonapophyses, distal articles; Fig. 25 – IXth gonapophyses, distal articles. Scale: 0.1 mm.

Discussion: Lepidospora (L.) mascareniensis sp. n., though known by the holotype female only, is well characterized among the remaining Afrotropical and Malagasy known species. *L. afra* Silvestri, from Kenya and Tanzania (SILVESTRI 1908 *b* and 1918). *L. meridionalis* Silvestri, from Natal and Zululand (SILVESTRI 1913 *a*) and *L. vilhenai* Silvestri, from Angola (SILVESTRI 1949), present a much longer ovipositor, which extends beyond the level of the IXth stylets by 1.5–2 times their own length (2/3–3/4 of this length in the new species); further, *L. meridionalis* and *L. vilhenai* present, both, a much thinner ovipositor composed by a greater number of articles (20–26 versus about 15 in the new species), and *L. afra* (with a similar number of articles) distinct Xth urotergite and a quite different subgenital plate. *L. insularum* Wygodzinsky, from the atlantic coast of the Cape Province (WYGODZINSKY 1955), presents a more deeply incised Xth urotergite, a distinct subgenital plate and a different cephalic chaetotaxy. *L. braueri* Escherich, from the Seychelles (ESCHERICH 1905), which female sex was described by CARPENTER (1916), presents a shorter ovipositor and not clearly annulated gonapophysis (not completely developed female though long as 11 mm?) shows a much more deeply incised Xth urotergite, a more rounded and enlarged subgenital plate and also (if Carpenter's figure is correct) an unique empodial claw shape.

Relatively to the Palearctic and Oriental described *Lepidospora* s. s., the new taxon seems to approach particularly *L. ceylonica* Silvestri, from Sri Lanka and India (SILVESTRI 1911) and *L. wygodzinskyi* Mendes, from the Kos and Rhodes Islands (MENDES 1992 and, as *L. escherichi*, WYGODZINSKY 1980), both with a similar ovipositor: however, the oriental taxon is clearly bigger (8 mm body length), with a distinct shape of the subgenital plate, a different chaetotaxy and a deeper excavation in the Xth urotergite, and the mediterranean species has shorter ovipositor, with a lower number of articles, and presents also a different chaetotaxy and a deeper Xth urotergal notch. *L. kurda* Mendes, from the iraqian Kurdistan (MENDES 1985) and *L. notabilis* Silvestri, from India (SILVESTRI 1913 *b*), both known by the males only, are completely isolated under the geographical point of view. All the remaining species show much shorter ovipositor, exceeding the level of the IXth stylets by no more than half their own length, as well as a much deeper Xth urotergite incision: *L. buxtoni* Silvestri, from the eastern Iraq (SILVESTRI 1923), *L. silvestrii* Wygodzinsky, from Israel (see WYGODZINSKY 1942) and *L. escherichi* Silvestri, from the Corfu island (SILVESTRI 1908 *a*. recently redescribed upon almost topotypical material off the greek islands of Leucade and Ipiros by MENDES 1985).

L. grassi Escherich, from Sicily and (?) continental Italy (?) (WYGODZINSKY 1980) and *L. gracilis* Escherich, from Sumatra (ESCHERICH 1905) are much more difficult to compare with the remaining *Lepidospora* s. s., on account of their short and undetailed descriptions; however, both belong to the 'long-type' ovipositor and *L. grassi* has, further, an atypical, enlarged, lepismatoid body shape.

***Coletinia mendesi* Wygodzinsky, 1980**

Material examined: Portugal – Lapa de Colaride (Cacém), 20/III/1993, 1 ♂ 1 ♀, leg. F. Regalo & R. Mergulho (CZ); *ibid.*, 11/IX/1993, 1 ♂, *ibid.*, (CZ). Lisboa, archaeological excavations of Sé Velha de Lisboa, nos claustros, no date, 1 young ♀, leg. R. Mergulho (CZ).

Coletinia mendesi was described upon material collected in the Algarve Province, southern Portugal (WYGODZINSKY 1980) and further recorded from southern Spain, in the Cordoba Province, Andaluzia (ROCA *et al.* 1985). The newly referred material, clearly enlarges northward (about 300 Km) the known distribution of the species, and the specimens from the Lapa de Colaride represent the first reference to *C. mendesi* as a troglobiont; the male collected in the 20th March, with 8.1 mm of body length, is much bigger than the type-specimen (6.7 mm only), though all the major features agree to what is mentioned in the original description; the typical elongation of the second tibia ventral macrochaetae, noticed as being longer than those of the remaining pairs of legs, is conspicuous even in the young female collected during the archaeological excavations in the old area of Lisboa.

Coletinia maggii (Grassi, 1887)

Material examined: France – Paris, Catacombes of the Museum, 26/XII/1947, 4 ♂♂ 1 ♀, no collector (MNHN).

Coletinia maggii was firstly collected in Italy (Sicily) and subsequently (WYGODZINSKY 1980) redescribed based on material from Italy mainland and from Yugoslavia, Dalmatia (now, Croatia); it was also mentioned for Malta and Italy (MENDES 1981) and for Austria and, again, for Italy (MENDES 1992). It is the very first time that the species is recorded to occur in France. The studied specimens, deposited in the entomological collection of the Paris Museum, were determined by Balazuc as *Nicoletia* sp.

ACKNOWLEDGEMENTS

I am deeply grateful to Dr P. Strinati, who collected, and to Dr V. Aellen, who loaned the single specimen of the new *Lepidospora* described below. We want to thank also Mrs F. Regala and R. Mergulho (both from the “Associação de Estudos Subterrâneos e Defesa do Ambiente” in Torres Vedras, Portugal) for the donated *Coletinia* collected in and around Lisboa, as well as to Miss Kelsner-Pillault, from the Paris Museum, for the sympathy and assistance during our survey of the *Zygentoma* collection several years ago.

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Une nouvelle espèce du genre *Ptychadena* (Anura, Ranidae) du Kenya

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A new species of the genus *Ptychadena* (Anura, Ranidae) from Kenya.

– Discovered during the Geneva Museum zoological missions (1974–1977) in Kenya, a new species of grass frog: *Ptychadena mahnerti* n. sp. is described. A highland savanna dweller, it is readily distinguished by its particular femoral pattern as well as by its voice. The other Kenyan *Ptychadena* species are compared and discussed.

Key-words: Amphibia – Ranidae – *Ptychadena* – Taxonomy – Biology – Kenya.

INTRODUCTION

Deux missions zoologiques du Muséum de Genève au Kenya (1974 et 1977) ont été accomplies par Volker Mahnert et l'auteur. L'important matériel herpétologique récolté n'a pas encore été totalement identifié et reste en cours d'étude.

Lors du premier voyage (1974), un ranidé du genre *Ptychadena* m'avait tout de suite suggéré la découverte d'une forme probablement nouvelle, mais un seul exemplaire capturé était insuffisant pour la définir. Au second voyage (1977), retrouvée dans diverses localités et assez bien observée dans son biotope, elle pouvait être reconnue. Un caractère flagrant qui la distingue des autres *Ptychadena* réside en son patron fémoral qui exhibe deux taches séparées sur chaque cuisse; chez les autres espèces du genre, ce caractère spécifique présente des patrons fémoraux différents: rayés, marbrés ou multi-tachetés.

Au Muséum de Nairobi, une confrontation de nos spécimens révéla que quelques exemplaires non identifiés ou mêlés à une autre espèce se trouvaient en collection. Ils provenaient des marais de Limuru où nous avons trouvé cette grenouille abondante. Enfin, le Dr Alex Duff-MacKay (Conservateur à l'époque) nous dit qu'il avait dans ses archives sonores, la voix enregistrée d'une *Ptychadena* species indéterminée de Limuru ... restée en question!

Elle est enfin décrite aujourd'hui.

***Ptychadena mahnerti* n. sp.**

Dédiée à Volker Mahnert, mon compagnon de mission.

Holotype: ♂ MHNG 2547.67, Kenya, Kiambu district, Limuru, (01°07'S 36°38'E), marais herbeux, 2250 m, 2 XI 1977. V. Mahnert et J.-L. Perret.

Paratypes: 2 ♂♂ MHNG 2547.68-69, 1 ♀ 2547.70, même localité et date. 2 ♂♂ MHNG 2547.71-72, Nakuru district, Njoro, 20 km S, marais, 2400 m, 7 XI 1977. 1 ♂ MHNG 1543.39, Elgeyo-Marakwet district, Tambach, 25 km E Eldoret, 1900 m, flanc de haut plateau s'abaissant sur le val Kerio, 17 XI 1974. 1 ♀ MHNG 2547.73, Embu district, Irangi Forest Station, 2000 m, 11 X 1977. 6 juv. MHNG 2547.74-79, Nyandarua district, South Kinangop, Njabini, forêt, zone de bambous, 2550 m, 9 XI 1977.

Matériel complémentaire: 152 juv. MHNG 2547.80 – 2549.30, Kiambu district, Limuru, marais herbeux, 2250 m, 1-2 XI 1977. 1 ♂, 1 ♀ BM 1970.293-294, Limuru, XI 1967, A. Duff-MacKay. 1 ♂ BM 1975.2286, Limuru, 11 V 1968, A.D. Forbes-Watson et A. Duff-MacKay.

D i a g n o s e : une *Ptychadena* du Kenya central, de taille moyenne (mâle = 35-42 mm, femelle = 45-49 mm); habitus ranoïde; membres postérieurs élancés; palmure réduite; patron fémoral avec deux taches séparées sur chaque cuisse, un caractère spécifique discriminant dans le genre; plis dorsaux fins, variables. Habitat: hauts plateaux, marais herbeux, lisière forestière, 2000-2500 m.

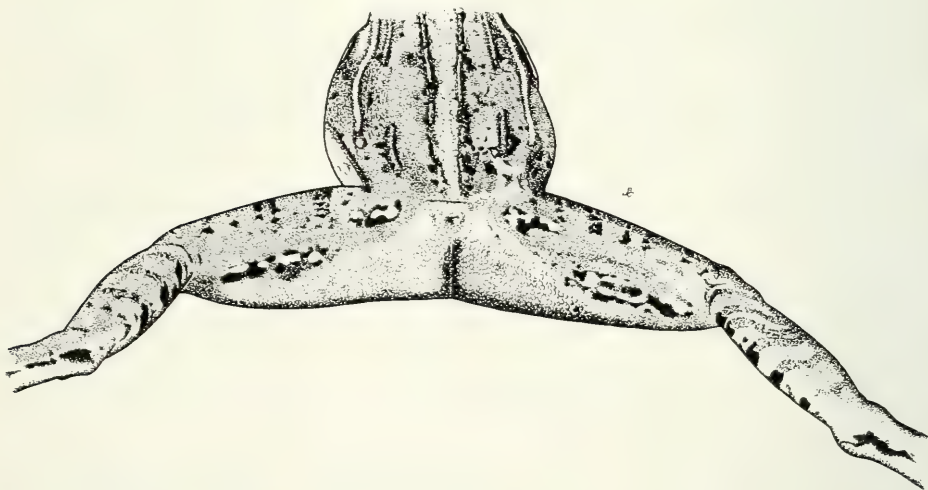


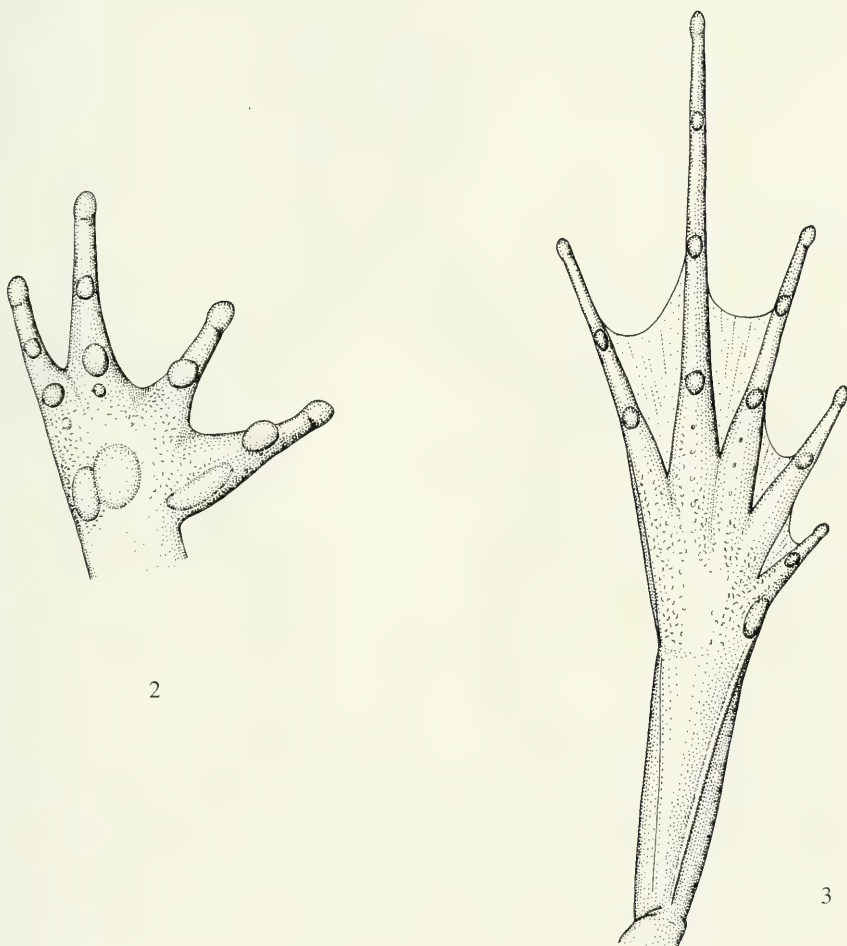
Fig. 1

Ptychadena mahnerti n. sp., paratype ♂ MHNG 1543.39 de Tambach. Patron fémoral spécifique avec deux taches marbrées distinctes sur chaque cuisse.

Description : habitus ranoïde, élancé chez le mâle, femelle plus trapue; dimorphisme sexuel de taille marqué ($\sigma/\text{♀}$ = 83 %); tête plus longue (σ = 14-15 mm, ♀ = 16-17 mm) que large (σ = 11-13 mm, ♀ = 13-15 mm); museau plus long (5.5-7.5 mm) que la longueur de la paupière supérieure (4-5.5 mm); canthus rostralis

mousse; loreum oblique, concave; narine à mi-distance entre l'oeil et le bout du museau; espace interorbitaire (3–3.5 mm) égalant ou dépassant de peu la largeur de la paupière supérieure (2.5–3 mm); diamètre du tympan (3–4 mm) mesurant les trois quarts de celui de l'oeil, environ égal à l'espace interorbitaire.

Membres antérieurs courts; main, mesurée du poignet à l'extrémité du troisième doigt (σ = 8–10 mm, φ = 9–11 mm) de même longueur que l'avant-bras; bras un peu plus court; doigts I et II subégaux, IV un peu plus long, doigt III le plus



FIGS 2-3

Ptychadena mahnerti n. sp., 2: main, face inférieure, forts tubercules subarticulaires, trois tubercules palmaires et deux surnuméraires, les derniers sont variables. 3: pied, face inférieure, tubercules subarticulaires modérés, métatarsien interne moyen, externe absent, vagues tubercules plantaires surnuméraires; palmure réduite.



FIG. 4

Ptychadena mahnerti n. sp., paratype ♂ MHNG 2547.71 de Njoro. Habitus, membres postérieurs élancés; plis dorsaux segmentés; patron fémoral à deux taches; barres coudées sur le tibia (caractère individuel).

long (longueur main); extrémité des doigts arrondie, bien formée; tubercules subarticulaires forts, celui du pouce le plus saillant; paume de la main chagrinée avec trois tubercules palmaires: un thénair elliptique, un médian rond, contigu à un externe allongé épousant sa forme; des tubercules surnuméraires variables, parfois présents au-dessous des doigts II, III, IV.

Membres postérieurs élancés, plus longs chez le mâle où l'articulation tibiotarsienne dépasse largement le bout du museau tandis qu'elle n'atteint pas ou dépasse de peu seulement l'extrémité du museau de la femelle; tibia plus long que la moitié du corps ($T/MA = 60\%$), plus long que la cuisse mais faiblement plus court que le pied ($T/P = 95\%$); tubercules subarticulaires moyens, arrondis; palmure pédieuse réduite, à demi développée; formule générale (phalange libre de palmure à chaque orteil, côté interne et côté externe): I ext. 1.75–2; II int. 2.25–2.50, ext. 1.75–2; III int. 3, ext. 2; IV int. 3.25–3.50, ext. 3; V int. 1.75–2.

Tubercule métatarsien interne modéré (1.8–2 mm), relié au talon par un pli tarsien (8–9 mm); tubercule métatarsien externe absent ou présent mais alors très petit et souvent mal défini; sole granuleuse avec des verrues variables, certaines alignées sous le quatrième métatarsien, alias tubercules plantaires surnuméraires.

Tégument dorsal garni de fins plis glanduleux variables qui diffèrent dans le détail chez chaque individu: externes plus épais parfois segmentés, de l'épaule à l'aîne, se terminant par des boutons; latérodorsaux à mi-corps plus ou moins allongés; postpalpébraux fragmentés, discontinus sur le bas du dos; médians naissant en arrière de l'oeil se terminant au milieu du dos; sacrés naissant entre les plis médians et convergeant vers l'anus, parfois plus courts et isolés au bas du dos; chez la femelle adulte, les plis peuvent être atténués voire effacés sur le dos; entre les plis la peau est lisse chez la femelle, chez le mâle elle est finement verruqueuse sur le bas du dos, les cuisses et les tibias où de faibles plis cruraux obliques sont décelables.

Flancs chagrinés réticulés. Tégument ventral lisse chez les deux sexes.

Coloration (en vie): dos généralement brun clair ou marron, rarement ocre rouge; de petites taches noires étroites alignées sur les plis sauf sur les externes uniformément clairs; une large raie médiane beige clair du museau à l'anus, présente ou absente; flancs plus ou moins maculés de noir vers l'avant; lèvre supérieure finement pigmentée, lèvre inférieure tachetée; bande canthale noire étroite du museau à l'oeil, recouvrant la narine; une large tache temporale noire contrastée, noyant le tympan, courbée en arrière, sa pointe terminale rencontrant l'extrémité du bourrelet labial postoculaire; derrière le bras un trait foncé du coude à l'articulation brachiale; devant le haut du bras une tache noire allongée se prolongeant sous la commissure labiale; avant-bras avec deux barres sombres et une tache noire sur le poignet; cuisse, face supérieure avec cinq barres brunes parfois dédoublées, face postérieure ornée de deux taches distinctes caractéristiques, marbrées de noir et jaune sur fond saumon, l'une plus courte en haut vers l'anus, l'autre plus longue en bas s'étendant du milieu de la cuisse au genou; un tel patron fémoral est unique dans le genre *Ptychadena*; tibia, face supérieure avec quatre barres foncées parfois obliques et coudées, une ligne claire longitudinale du talon au genou, présente ou absente, côté interne avec une rangée de taches noires massives espacées, côté externe avec des taches sombres



FIG. 5

Ptychadena mahnerti n. sp., paratypes (en haut) ♂ MHNG 2547.69 de Limuru; (en bas) ♀ MHNG 2547.73 d'Irangi, coloration ocre, plis dorsaux effacés.

variables souvent confluentes; tarse et métatarse barrés de brun sur le côté externe. Face inférieure: tête et ventre blancs, cuisses dorées, région anale et tibias rosés.

Caractères mâles: dimorphisme sexuel de taille marqué ($\sigma/\varphi = 83\%$); bas du dos, cuisses et tibias finement verruqueux; callosité nuptiale enrobant la base du pouce, développée sur le deuxième doigt et le côté interne du troisième; sacs vocaux s'ouvrant par des fentes bilatérales obliques de 5–6 mm, dirigées vers l'insertion brachiale, type infère.

V o i x : les appels sont émis en séries successives de 'rreu rreu rreu...' rapides et vibrants comme une rafale de mitrailleuse, d'une tonalité assez grave; l'analyse par sonagramme et vitesse ralentie révèle qu'une série isolée contient 4 à 13 cris ou figures, chaque cri, durée moyenne 0,07 s (0,03–0,11) est un trille composé de 4 à 11 notes ou segments, soit toujours 4 ou 6–7 ou 10–11 notes; fréquence dominante 3 KHz, harmoniques 6–7 KHz.

Cette vocalisation rappelle celle de *Ptychadena schillukorum* qui émet des séries de cris plus brèves et de tonalité plus grave.

Habitat: savane humide et prairie de plateaux élevés (2000–2500 m), lisière et clairières forestières; reproduction en marais herbeux et étangs permanents.

D i s t r i b u t i o n : zone montagneuse du Kenya s'étendant du nord de Nairobi (Limuru) vers les Mts Kenya et Elgon.

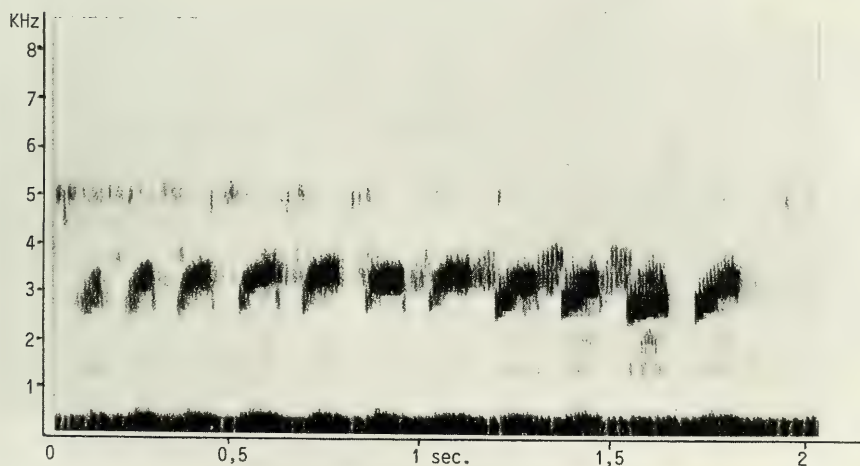


FIG. 6

Ptychadena mahnerti n. sp., sonagramme de l'appel nuptial, une série de onze figures (variation 4–13). Limuru.

COMMENTAIRE ET DISCUSSION

Dans le genre *Ptychadena*, l'ornementation de la face postérieure de la cuisse offre un caractère spécifique original. Chez *Pt. mahnerti*, ce patron fémoral permet à lui seul de distinguer cette nouvelle espèce de toutes les autres du genre. En effet, deux taches distinctes sur chaque cuisse, rarement confluentes chez quelques individus, ne s'observent pas ailleurs parmi les espèces connues.



FIG. 7

Ptychadena mahnerti n. sp., lieux de récolte de cette espèce inédite (en italique): Tambach, Njoro, Limuru, Kinangop, Irangi, Nyambeni Hills, alt. 2000–2500 m.

TABLEAU I

Ptychadena mahnerti n. sp. Données morphométriques en mm: MA = longueur museau-anus; T = longueur tibia; P = longueur pied

Paramètres	Sexe ♂	N = 4	Sexe ♀	N = 2
MA	35–42	M = 39.25	45–49	M = 47.00
T	22–26	M = 24.25	24–31	M = 27.50
T/MA %	60.9–62.8	M = 61.81	53.3–63.2	M = 58.25
P	23–27	M = 25.25	26–32	M = 29.00
P/MA %	63.4–65.7	M = 64.37	57.7–65.3	M = 61.50
T/P %	95.6–96.2	M = 96.00	92.3–96.8	M = 94.55

Commentaires: dimorphisme sexuel de taille marqué (σ/φ = 83 %); tibia (T/MA = 60 %) et pied (P/MA = 63 %), plus longs que la moitié du corps; pied (T/P = 95 %), plus long que le tibia.

Les *Ptychadena* recensées au Kenya par les auteurs (LOVERIDGE 1957; DUFF-MACKAY 1979; INGER 1968; FROST 1985; POYNTON & BROADLEY 1985) diffèrent encore diversement: *Pt. oxyrhynchus*, de taille bien plus grande et fortement palmée; *Pt. anchietae*, *Pt. mascareniensis*, *Pt. mossambica*, *Pt. porosissima*, toutes également à palmure plus développée et à plis dorsaux réguliers plus marqués; *Pt. schillukorum*, forme plus trapue à membres postérieurs plus courts et palmure plus forte; enfin, *Pt. stenocephala* (confondue avec *Pt. chrysogaster*, DUFF-MACKAY 1979), récoltée à Rapogi, Province Nyanza bordant le lac Victoria, est une espèce très svelte à palmure extrêmement réduite, bien différente de *Pt. mahnerti*.

Ecologie et distribution: très largement répandues en savane, du niveau de la mer jusqu'à l'étage montagnard, *Pt. anchietae* et *Pt. mascareniensis* sont sympatrides de *Pt. mahnerti* à la limite altitudinaire dans certaines localités (Tambach); *Pt. mossambica* et *Pt. schillukorum*, savanicoles planitaires, distribuées de la côte sud vers le nord plus aride et la Somalie, sont nettement allopatrides; *Pt. oxyrhynchus* est connue de la côte sud, des Shimba Hills ainsi qu'à l'ouest en forêt de Kakamega (DUFF-MACKAY 1979); nous avons récolté *Pt. porosissima* à Endebess au pied du mont Elgon, à 2000 m, cette forme de hauts plateaux africains est probablement aussi sympatride de *Pt. mahnerti* au Kenya.

Par sa palmure pédieuse laissant libres deux phalanges aux orteils III et V ainsi que trois phalanges ou plus à l'orteil IV, *Pt. mahnerti* entre dans le groupe des formes de *Ptychadena* à palmure réduite (Perret 1994).

Par sa voix propre, elle se distingue de toutes les autres espèces connues du genre.

REMERCIEMENTS

Raymond Laurent et Robert Drewes ont confirmé mes vues sur cette espèce inédite. Malcolm Largen m'a aimablement communiqué les numéros des spécimens en collection au British Museum. Les dessins ont été interprétés par Gilles Roth, les photographies réalisées par Claude Ratton au Muséum de Genève.

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A new lygosomine skink (Lacertilia: Scincidae: *Panaspis*) from Cameroon

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A new lygosomine skink (Lacertilia: Scincidae: *Panaspis*) from Cameroon. - A small skink from Mt. Kupe, Cameroon, is described as *Panaspis chriswildi* sp. n. It proves to be the third species of the *Lacertaspis* group within *Panaspis*, next to *P. reichenowii* and *P. rohdei*. This subgeneric assignment is corroborated by the ultrastructure of the scale surface.

Key-words: Lacertilia - Scincidae - *Panaspis* (*Lacertaspis*) *chriswildi* sp. n. - Cameroon.

INTRODUCTION

In 1995, a collection of skinks of the lygosomine genus *Panaspis* was kindly donated to the ZFMK by Christopher Wild, Loughborough/England, who had collected it, partly in association with Mr. Ulrich Hofer, Berne/Switzerland, on Mt. Kupe, Cameroon (see WILD 1993, 1994). This material, collected at different altitudes, contained representatives of three subgenera: *Panaspis* s. str., *Leptosiaphos* and *Lacertaspis* (sensu PERRET 1975). Of the latter, both closely related species (PERRET 1973) which form this subgenus, viz. *P. (L.) reichenowii* and *P. (L.) rohdei*, were represented, by ZFMK 59535–536 and ZFMK 59529–534 respectively. An additional specimen resembled *P. reichenowii* by the possession of two, big blackish parietal spots (which were considered to be diagnostic for this species), but differed strikingly by head and body proportions and scalation characters. After having compared this material with the respective holdings of the Muséum d'histoire naturelle, Genève (MHNG), and former acquisitions of the Museum A. Koenig, Bonn (ZFMK), the above-mentioned lizard is described here as:

***Panaspis* (*Lacertaspis*) *chriswildi* sp. n.**

Diagnosis: A medium-sized species (total length less than 11 cm) of the *Lacertaspis* section of *Panaspis* (see PERRET 1975, PERRET & WÜEST 1982), which differs from *P. (L.) reichenowii* by only slightly enlarged preanals, 26 scales around

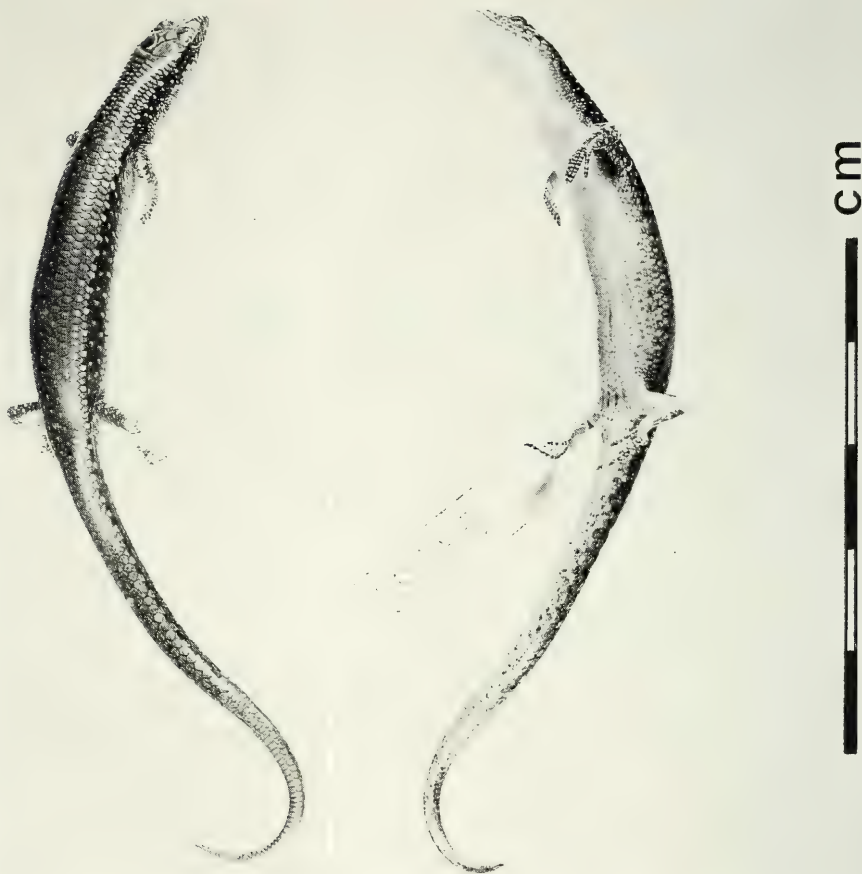


FIG. 1

Dorsal (left) and ventral (right) view of the holotype of *Panaspis (Lacertaspis) chriswildi* sp. n.

midbody, a less pointed snout, larger parietal spots and a triangular first loreal; it differs from *P. (L.) rohdei* by the smaller size, the presence of parietal spots and shorter limbs. It is distinguished from both species by 18–19 lamellae under the fourth toe and 2 pairs of enlarged nuchal scales.

Holotype: ZFMK 59537, ♀ (Fig. 1 et 2), Cameroon: Mt. Kupe, 1550 m a.s.l., C. Wild, 18.V.1994.

Head-body length 45 mm, tail length 58 mm + (regenerated). Habitus slender, lacertiform, tail round in cross section, not laterally compressed. Limbs well developed, pentadactyle, without web rudiments at the basis of the toes. Head stout with



FIG. 2

Lateral (above) and dorsal (below) view of the forepart of the holotype of *P. (L.) chriswildi* sp. n. Note the black patches on the parietal shields.

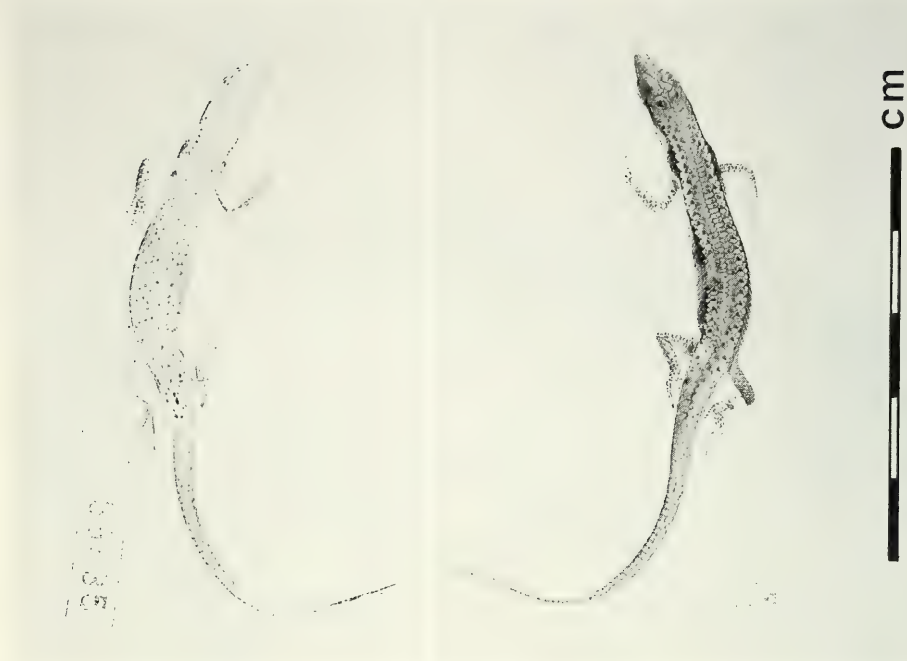


FIG. 3

Ventral (left) and dorsal (right) view of *P. (L.) reichenowii* (sympatric specimen from Mt. Kupe).

a pointed snout, not broader than midbody. Distance from tip of snout to anterior margin of eye a bit shorter than that from posterior eye margin to ear opening, which is small and roundish. Lower eyelid with a large, transparent disc. 4 supraoculars, 7 supraciliaries on either side. Rostral twice as wide as high. Internasal approximately one third wider than long. Nostril situated in an undivided nasal, smaller than ear opening. No supranasals. Prefrontals widely separated from each other. Two loreals, the first of them small, triangular, its tip pointing on the supralabials; second loreal approximately twice as large as the first one, pentagonal, anteriorly more or less pointed. Frontal longer than its distance from the tip of snout, roughly as broad as the parietals. Frontoparietals smaller than the frontal, ca. three times larger than the interparietal. Parietalia wider than long, each with a large blackish spot. Two pairs of enlarged nuchals. 5 supralabials on either side, the fourth one below the eye. 26 scales around midbody, smooth, but each with two brownish longitudinal heels which may be misinterpreted as keels. The two medial dorsal scale rows slightly enlarged, preanal scales nearly not enlarged. Subcaudals transversely widened. 18–19 subdigital lamellae under the fourth toe.

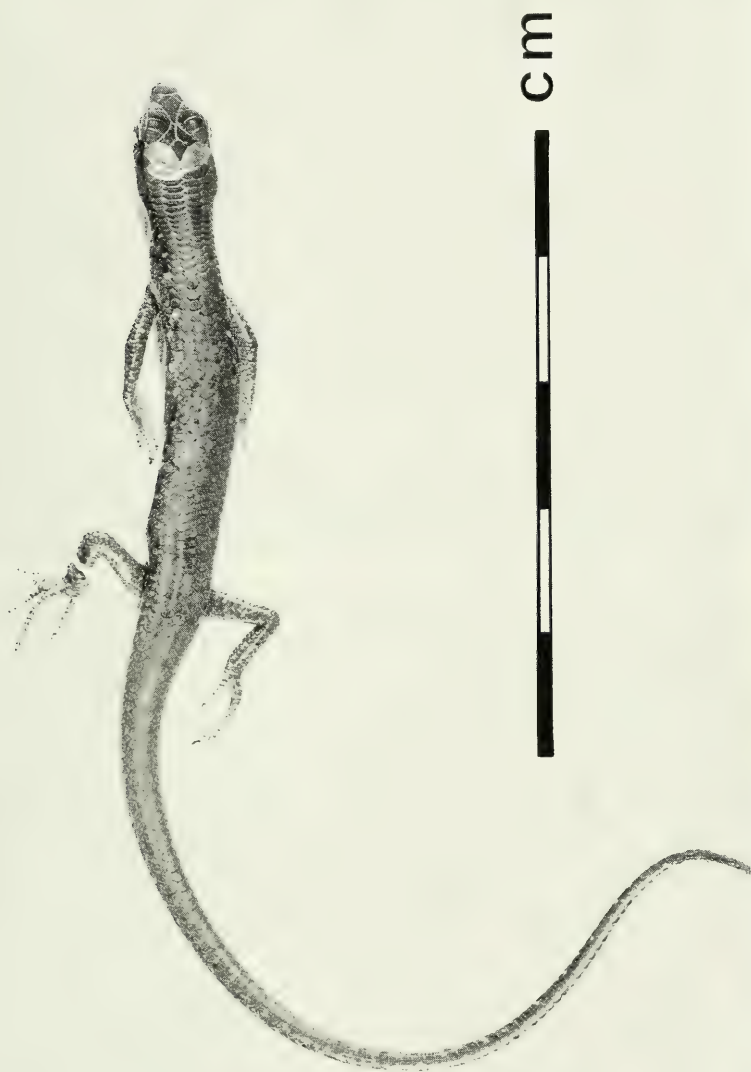


FIG. 4

Dorsal view of *P. (L.) rohdei* (sympatric specimen from Mt. Kupe).

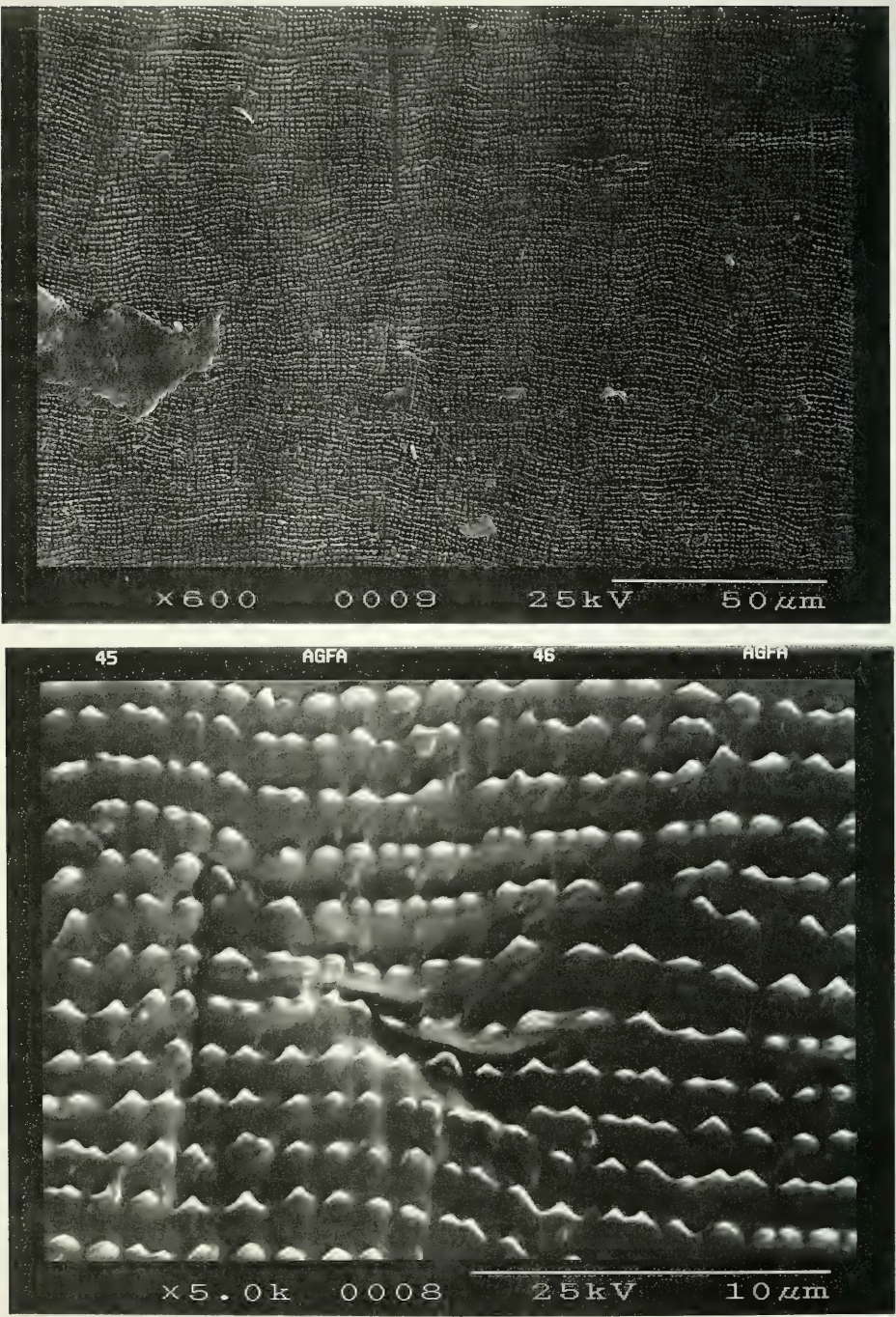


FIG. 5. Epidermal ultrastructure of *P. (L.) chriswildi* sp. n.



FIG. 6

Holotype of *P. (L.) chriswildi* sp. n. in life.

Upper parts brownish, with scarcely distributed light spots. A broad lateral band, running from behind the eye to the tail tip, also spotted with light dots, and becoming narrower from midbody hindwards. Between lower eyelid and tympanum a big, light fleck (Fig. 2). 3 dark transverse bars on the sutures of the supraocular scales. Upper side of limbs spotted with light dots. Fingers and toes with a marked brown-white annulation. Lower parts whitish, with dark spots mainly in the inguinal and cloacal region. The colouration of the living specimen is documented in fig. 6.

COMPARISONS

Although only one specimen of *P. chriswildi* sp. n. is available, it differs so clearly from its relatives that its specific distinctness is beyond any doubt. As stated in the diagnosis, its greatest affinities are with *P. reichenowii* (Fig. 3) and *P. rohdei* (Fig. 4), i.e. the two species forming the subgenus *Lacertaspis* Perret, 1975. According to PERRET (op. cit.: 11) *Lacertaspis* is among else characterized by a lacertiform habitus, a long tail, smooth, proximal caudilateral scales, robust, pentadactyl limbs overlapping when adressed, and a great, visible, superficial tympanum. These characters are most likely connected with the habitat and habit, i.e. they could well be parallel adaptations rather than synapomorphies documenting a monophyletic group. The remaining — scalation — characters used as diagnostic occur also in the other subgenera (see PERRET 1975: table, p. 13).

In a later study, however, PERRET & WÜEST (1982) were able to detect an interesting new feature, viz. the ultrastructure of the scale epidermis. It turned out that the two species assigned to *Lacertaspis* showed a common pattern which distinguished them from all other *Panaspis* species studied. Although a polarity decision was neither made by PERRET & WÜEST (op. cit.) nor can it be done here, the common microdermatoglyph pattern of *P. (L.) reichenowii* and *P. (L.) rohdei* supports their joint delimitation from the subgenera *Panaspis* and *Leptosiaphos* better than the scalation and proportion differences.

P. chriswildi shows exactly the same pattern of epidermal ultrastructure (Fig. 5) as *P. reichenowii* and *P. rohdei* (see fig. 7 in PERRET & WÜEST, op. cit.: 277). We assign it therefore as the third species to *Lacertaspis*. The diagnosis of this subgenus has, however, to be modified accordingly: Habitus sepsinoïd to lacertiform; tympanum large, superficial to small, recessed; subarboricolous forms of lowland forest to terrestrial forms of (sub-)montane forest. This means that *Panaspis (Lacertaspis) chriswildi* bridges the morphological gap between *Lacertaspis* and *Leptosiaphos* as far as adaptive, habitat-related characters are concerned. Within *Lacertaspis*, *P. chriswildi* seems to be closer to *P. reichenowii* than to *P. rohdei*. The unique parietal flecks, not occurring in any other *Panaspis*, links it with the former, as does the ventral spotting. We regard therefore *P. reichenowii* to be the sister species of *P. chriswildi*. More material to be collected has to further clarify the systematic and ecological position of this remarkable new skink.

Etymology: The new species is dedicated to the collector of the holotype, Chris Wild, in order to acknowledge his continuous support and cooperation.

ACKNOWLEDGEMENTS

In addition to the collector of the relevant material, Christopher Wild, Loughborough, who provided also the colour photograph of the holotype, we are indebted to Dr Wolfgang Speidel and to Jörn Köhler (both ZFMK Bonn) for their valuable help with the SEM and the habitus photos. Ursula Bott (ZFMK) helped preparing the manuscript.

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ANNALES

de la
SOCIÉTÉ SUISSE DE ZOOLOGIE
et du
MUSÉUM D'HISTOIRE NATURELLE
de la Ville de Genève

tome 103
fascicule 4
1996



REVUE SUISSE DE ZOOLOGIE

TOME 103 — FASCICULE 4

Publication subventionnée par l'Académie suisse des Sciences naturelles
et la Société suisse de Zoologie

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ANNALES

de la
SOCIÉTÉ SUISSE DE ZOOLOGIE
et du
MUSÉUM D'HISTOIRE NATURELLE
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tome 103
fascicule 4
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ZOOLOGIA ET BOTANICA 96

Fribourg, 21-23 February 1996

(Annual Conference of the Swiss Zoological Society)

Determinants of community structure in plants and animals

ABSTRACTS

R. Arditi (Institut de zoologie et d'écologie animale, Université-Dorigny, 1015 Lausanne et Écologie des populations et communautés, Bâtiment 362, Université Paris-Sud XI, F-91405 Orsay Cedex, France): Stability and complexity – what do density – dependent food webs bring?

The link between complexity and stability is one of the oldest theoretical questions of community ecology. Based on the observation that complex ecosystems (e.g., tropical forests) incurred apparently small fluctuations, the accepted viewpoint for 50 years was that complexity generated stability. In the early 70's, May's theoretical work reversed the paradigm: mathematical models of randomly assembled communities showed that the more complex they were, the less probable that they would be stable. This work was later refined and more thoroughly developed by Pimm in the context of food webs. An important restriction of May's models was that they were linear, assuming that communities were always close to equilibrium. Although Pimm investigated non-equilibrium situations, he assumed that trophic interactions were density-independent, i.e., that the amount of resources consumed by an individual consumers did not depend on the number of conspecifics. Presently, there is little doubt that density-dependence is frequent in nature as well as in laboratory conditions. Model food webs with strong density-dependence are not easy to develop. One type of such model will be presented. First results show that these webs possess unique properties that could not be foreseen from density-independent models. These properties make them more realistic and suggest a possible reconciliation between theoretical predictions and empirical observations.

C. Arnold, A. Buttler & B. Werffeli (University of Neuchâtel, Switzerland): Ecological determinism of bryophyte community patterns in alluvial steppes.

Alluvial steppes are brushwood communities characterised by xero-thermophilous species. Despite these steppes represent functional units with increasing disconnection to the alluvial system, they reveal the highest species pool (184 herbaceous species) among all the communities recorded in the Swiss alluvial zones of national importance, after the White Alder flood plain forest (about 250 species). Unfortunately, as a transitional stage, where the bank cannot be reached any longer by the river, *Picea abies* becomes an invasive species and *Pinus silvestris* and *Betula pendula* may grow tall, turning the general ecological conditions towards a more forested environment, with a related loss of species diversity.

In this paper we aim at understanding, by means of spatial multivariate statistics, the ecological determinism of the Bryophyte community patterns. Three plots representing a successional gradient towards a tree dominated environment are investigated. It is shown how the vegetation structure changes in relation to the shift from exogenous to endogenous ecological conditions and how the spatial component can be used in detecting some structural features.

T.C.M. Bakker, D. Mazzi & S. Zala (Zoologisches Institut, Universität Bern): Enhanced transmission of the parasite *Pomphorhynchus laevis* through behaviour and colour changes in its intermediate host, *Gammarus pulex*.

Parasites with a complex life cycle involving several host species often induce changes in their intermediate hosts. The parasite-induced changes make the intermediate host a more profitable prey to the next host of the parasite thereby increasing the chances of transmission of the parasite.

The acanthocephalan parasite *Pomphorhynchus laevis* is transmitted by the amphipod *Gammarus pulex* to its next host, fish. The parasite is clearly visible through the transparent cuticle of *G. pulex* as a conspicuous orange spot. Additionally, with the onset of infectivity of *P. laevis* to its next host, *G. pulex* shows a changed photoreaction; it becomes photophilic and positively phototactic. Hungry stickleback fish, *Gasterosteus aculeatus*, preferred to eat infected *G. pulex* over uninfected ones. By means of experimental manipulation of the colour effects of the parasite in its intermediate host, we showed for the first time that both behavioural and colour changes in the intermediate host promote parasite transmission in such acanthocephalan systems.

A. Baur, L. Fröberg & B. Baur (Institut für Natur-, Landschafts- und Umweltschutz, Universität Basel; Dept. of Systematic Botany, University of Lund): Herbivory in a calcicolous lichen community: effects of selective snail grazing.

The land snails *Chondrina clienta* and *Balea perversa* coexist on old stone walls where they feed on calcicolous lichens. Previous studies showed that both intra- and interspecific competition most probably for food occur in these species. A total of 32 calcicolous lichen species, one alga and one bryophyte were recorded on a limestone wall in the grassland Great Alvar on the Baltic island of Öland, Sweden. Fourteen (41%) of these 34 species and free-living cyanobacteria showed herbivore damage, most probably due to grazing by the land snails *Chondrina clienta* and *Balea perversa* that inhabited the limestone wall. Three laboratory experiments were conducted to examine the food preferences of individuals of *C. clienta* and *B. perversa* collected at this site and to evaluate any association between their preference and the net food quality of the lichens to the snails. *C. clienta* and *B. perversa* exhibited food preferences, which differed significantly between species. Within species, variation in food choice was similar among individuals. This indicates that snail populations may be composed of polyphagous individuals with similar food preferences. Different lichen species were of different net food quality to the snails as indicated by growth rate differences. In both snail species the most preferred lichen species of the choice experiment caused the largest weight increase in juveniles, viz. *Caloplaca flavovirescens* in *C. clienta* and *Aspicilia calcarea* in *B. perversa*. This suggests that the snail species studied differ in their abilities to deal with secondary compounds and physical characteristics of certain lichens or that they can utilize the energy and nutrients of these lichens to a different extent. It is suggested that differential food preferences might reduce the intensity of interspecific competition for resources (lichens) between *C. clienta* and *B. perversa*.

G. Bernasconi & L. Keller (Universität Bern, Ethologische Station; IZEA, Université de Lausanne): Reproductive conflicts in cooperative associations of Fire Ant queens (*Solenopsis invicta*).

In ants unrelated queens frequently associate to initiate a colony cooperatively. The joint reproductive effort of the cofoundresses increases growth and survival of the incipient colony. Yet, such associations are unstable. Soon after emergence of the first workers, queen-queen and queen-worker fights lead to the death or expulsion of all but one cofoundress. Because no sexual offspring are produced in incipient colonies the surviving queen mono-

polises the entire future reproductive success of the colony. Two factors, the queens' relative fighting ability and their relative contribution to worker production (assuming that workers can recognize and selectively favour their mother) have been proposed to influence the survival prospects of individual queens within associations. The effect of these two factors were tested in the fire ant *Solenopsis invicta*. Initial size differences, a potential measure of the queens' fighting ability, affected the outcome of the conflicts, so that the initially heavier queen was more likely to survive. Differential weight loss by initially equal nest mates was also related to survival, with the queen losing more weight being more likely to die. The manipulation of the queens' relative contribution to the worker brood had no significant effect on the queens' survival probability, suggesting that workers are unable to favour their mother.

L. Bersier & G. Sugihara (Scripps Institution of Oceanography, UC San Diego): Scale invariance versus scale dependence in food web properties.

There is a current controversy as to the scaling behaviour of food web properties. Earlier studies based on large collections of food webs found that some food web properties (e.g., the link density, the fractions of top, intermediate and basal species) were scale invariant: they remained constant across webs of different sizes. These scaling properties fostered the formulation of interesting hypotheses on how food webs are assembled and how they operate. However, together with criticisms of the data used to demonstrate these properties, recently compiled food webs have cast doubt on the validity of the scale invariant laws. Moreover, the scale invariance found in some data sets has recently been challenged. The properties may indeed vary with web size. The scale dependent hypothesis appears to be the new paradigm in food web theory. Here, we review the evidence in favour of both hypotheses, and show that the scale dependent hypothesis is weakly supported empirically. More specifically, for one large collection of food webs, we analyze systematically a suite of competing models describing the relationship between food web properties and web size. We present quantitative evidence that the most robust model is a piecewise linear regression, indicating that food web properties are bounded to different scaling regions. The properties of small webs exhibit scale dependence, while they are scale invariant for large webs. Finally, we discuss the generality of the link density property, and point out its extreme sensitivity to sampling effort.

W. Brown (Institut de Zoologie et d'Écologie Animale, Université de Lausanne): Female choice for an indicator of male competitiveness in the Black-horned Tree Cricket.

Although evidence of mate choice is now well founded, distinguishing among alternative evolutionary models of female choice remains problematic. An approach that has been surprisingly under-utilized is the study of functional design or teleonomy. Models of sexual selection make fundamentally different predictions about the way in which preferences should be structured. I studied the design of female choice for song in Black-horned Tree Crickets, predicting from indicator models that choices should be (1) based on comparisons, (2) directed at elements of sex-limited signals that indicate fecundity benefits and/or heritable fitness, and (3) these elements should lack susceptibility to cheating. These predictions were contrasted with the predictions from runaway models that choices should (1) be fixed within females and (2) show consistent variability among females. Results showed that comparisons were necessary for choices, females preferred low-frequency songs, and low frequency was a reliable indicator of both fecundity and putative heritable benefits of mating, supporting all 3 predictions of indicator models. By contrast, female preferences were neither fixed within nor variable among females, falsifying the necessary conditions for runaway selection. Combining these results with genetic studies of mate choice will determine the model of sexual selection that is operating on cricket song.

P. Charlier, P. Furst, G. Blandenier & S. Pozzi (Plant Ecology and Biogeography Laboratory, University of Geneva; Laboratory of Animal Ecology, University of Neuchâtel; Natural History Museum of Geneva): Arachnological and botanical transect from a forest's rim to a wet meadow.

We studied in 1992 and 1993 the characteristics of spiders' communities of small natural areas with ecological conditions as wide as an Oak forest's rim (*Quercus robur*, *Q. petraea*), a wet meadow containing mainly *Molinia arundinacea* and a sword-flag (*Gladiolus paluster*) and a tilling field in full regeneration. All these plant communities are gathered on a 35 meters long line. What are the variations, speaking of specifications and quantities of spiders' communities in the wet meadow;— over a year from March to October 1992; — with three different kinds of mowing management? The trapping's method of Barbers has been used.

I. Dajoz, J. Shykoff, Y. Loublier, M.H. Pham-Delegue & I. Till-Bottraud (Laboratoire d'Écologie, Université de Paris 6; ESV, Université de Paris 11; Institut für experimentelle Ökologie ETH Zürich; Neurobiologie Comparée des Invertébrés, INRA; Biologie des Populations d'Altitude, Université de Grenoble): Pollinator mediated selection on pollen morphology in the genus *Viola*.

Many plants produce several pollen morphs differing in aperture number. Species of *Viola* exhibit this heteromorphism, with pollen with 3–6 apertures. The more apertures a pollen grain has, the more quickly it germinates, but the shorter its life-span is. Theoretical models find an ESS for several pollen morphs. Models predict a higher proportion of many-aperturate pollen grains on plants that receive more pollinator visits. Lastly, variation in ploidy level can lead to variation in pollen aperture number. Our aim in this paper is to address the following questions:

What is the distribution of pollen heteromorphism in *Viola*? Is pollen heteromorphism in *Viola* solely due to variations in plant ploidy level? Or, can selection act on proportions of different morphs? What is the nature of this selection?

For the 2 subgenera of *Viola*: pansies (18 spp.) are heteromorphic, with no correlation between chromosome number and mean aperture number. In violets (12 spp.) those with $2n = 20$ are monomorphic, those with $2n = 40$ are heteromorphic.

In pansies there is a negative correlation between elevation of collection site and mean aperture number. This agrees with our predictions of the model: pollination limitation at high elevation should select for low aperture number.

Within species, there is a positive correlation between flower or spur size, and mean aperture number. Also, pollinators prefer large flowers.

These data suggest that some selection pressures act on pollen grain morphology, and that these selective pressures are partly due to differences in pollinator activity.

M. Fischer & D. Matthies (Institut für Umweltwissenschaften, Universität Zürich): Conservation biology of rare grassland plants in the Swiss Jura mountains.

In a comparison of vegetation records from 26 grasslands in the Swiss Jura mountains from 1950 and 1985 short-lived species with low local abundance and high habitat specificity showed the highest rates of local extinction. The biennial *Gentianella germanica* belongs to this group. Populations of *G. germanica* had a low mean annual population growth rate (0.84) with large spatial (among seven sites) and temporal variation (among the years 1993–95). In a survey of 23 populations number of seeds per plant was reduced in small compared with large populations. The population growth rate estimated from the number of flowering plants 1993, 94 and 95 showed the same pattern. This could be due to poorer habitat quality, disruption of plant-pollinator mutualism or genetic erosion in small populations. However, habitat properties did not explain the pattern and hand pollination did not increase seed set as compared with open pollination, whereas genetic variation as measured with RAPD-PCR was reduced in

smaller populations. Management of the species should avoid disturbance during the time of flowering or fruit set and allow disturbance that leads to the creation of vegetation gaps, because it improves seedling establishment. Conservation biology should integrate from the gene to the community, use descriptive and experimental methods and study spatial scales comprising several to many populations.

D. Fraefel, M. Haffner & V. Ziswiler (Zoologisches Museum der Universität Zürich): Morphological and micro-anatomical investigations of the integument of the European red squirrel *Sciurus vulgaris* L., 1758 (Mammalia, Rodentia).

The Red squirrel *Sciurus vulgaris* shows adaptations in its body for the arboreal way of life. Morphological and micro-anatomical investigations of the integument of different parts of the body were carried out to find such adaptations and relate them to their functions. The Red squirrel has vibrissae on the head, on the forelimbs, on the breast and on the abdomen. While the number of Vibrissae mystaciales and the Vibrissae anconaeales is constant, the number of the other vibrissae shows an intraspecific variability. For the first time an accumulation of apocrine glands was found on the chin of the Red squirrel. These glands occur on both sides of the chin near the corner of the mouth and are present in both sexes. The secretions may be spread on the head with the forefeet during face-wiping. Eccrine glands occur in all foot pads. Instead of the tarsal pads, sparsely haired areas occur on the heels. There, the hairs are equipped with enlarged sebaceous glands. The secretions of these glands may be used for scent-marking the frequently visited feeding places. The forefeet are adapted to grasp twigs and handle food. Both carpal pads contain muscles and cartilage. They provide, together with the reduced first digit, an abutment against the grasping digits two to five.

J. Frantzen (Institut de biologie végétale, Université de Fribourg): Avoidance and resistance in the weed pathosystem *Senecio vulgaris* L.–*Puccinia lagenophorae* Cooke.

The rust fungus *P. lagenophorae* might be used to control the annual weed *S. vulgaris*. A system management approach of biological weed control, which is followed to study the suitability of *P. lagenophorae* as biological control agent, is presented. The system management approach both depends on, and also provides, fundamental knowledge of mechanisms at the individual and population level. One study of the ongoing research was directed to the disease defence mechanisms of avoidance and resistance in the weed pathosystem *S. vulgaris*–*P. lagenophorae*.

In an integrated approach, three plant lines of *S. vulgaris* were tested for avoidance of, and resistance to infection by *P. lagenophorae*. Differences in susceptibility to *P. lagenophorae* infection between plant stages were determined independent of plant line. Plant lines differed also in growth rate, and so, the fraction of plants in the most susceptible plant stage at the time of inoculation differed between plant lines. The combination of the effects of plant stage on infection and plant line on growth rate resulted in differences in avoidance of *P. lagenophorae* infection between plant lines. Differences in resistance to *P. lagenophorae* infection between plant lines were determined in one of the two experiments. The results are discussed with respect to the impact of pathogens on plant populations.

J. Georgakopoulos, J. Berlie, V. Derivaz & B. Reverdin (Laboratoire d'Éthologie, Université de Genève, rte des Acacias, 1227 Carouge): Structuring space through path integration.

Recent theories of navigation postulate that path integration may be linked with a stable representation of space. Thus, the subject can constantly update its position on this "map" by keeping track of its own movements through path integration. Likewise, path integration may be used during exploration to place relevant sites or cues in space. The first experiment studies

the interaction between path integration and visual cues in golden hamsters (6 subjects). The subjects are trained to find food in one of four identical cylinders which are distinguishable only by their location. No other visual cues are present. In test trials, the subject is led in darkness along a new path to a given release point. The light is then switched on and the animal goes to the food source on its own. The subjects chose the correct cylinder in 86% of test trials. This successful orientation can be explained in two ways: 1) By keeping track of its movements through familiar space, the subject can anticipate a given visual panorama. When the light comes on, it can then compare what it sees with this anticipated view in order to identify the correct goal. The goal can then be reached using the visual cues. 2) The hamster may orient towards a point in absolute space independently of visual cues, by storing a vector linked to the position of the goal. It can then at any moment locate the goal by combining the short-term vector derived from path integration (which gives the animals present location) with the memorised vector associated with the goal. The second possibility was verified by repeating the first experiment in total darkness. In a high percentage of trials (33%) the subjects refused the task. However, when the animals attempted to reach the goal they succeeded in 99% of these trials (64% of the total). In a final experiment no external cues mark the goal. All hoarding trips are carried out in total darkness, eliminating visual information. The animal is trained to find food in a constant location. In test trials it is led along a new path to a given release point from which it must go to the goal. In this situation, where nothing indicates that the goal has been reached, the animals usually do not stop at the correct location. However, in 56% of trials, the subject reaches this location by a fairly straight path (up to 1.5 times the shortest possible path). These last two experiments suggest that hamsters are indeed able to use path integration in conjunction with their knowledge of a familiar environment; nevertheless, path integration appears to require additional confirmation before the subject acts on this information.

L. Gigord (Laboratoire d'Évolution et Systématique, Université Paris XI-CNRS, Laboratoire de Biologie et Physiologie Végétale, Université de La Réunion; Conservatoire National Botanique de Mascarin, Ile de La Réunion): Inbreeding depression in two natural and fragmented populations of an endemic and self-incompatibility tree of La Réunion Island (Mascarenes Archipelago, Indian Ocean): '*Dombeya acutangula* Cav. (Sterculiaceae).

La Réunion Island resembles other volcanic islands (Hawaii, Galapagos...) with exceptional flora of approximatively one thousand of endemic and indigenous species. Habitat fragmentation has reached a critical level within forest formations at low altitude with ever increasing anthropisation following the arrival of man three centuries ago. The lack of biodiversity and rapidly decreasing habitat have become a major concern for the various island authorities.

This study is to examine the consequences of fragmentation of natural habitat on a species endemic of the archipelago: *Dombeya acutangula* Cav. Two very different island populations have been examined: one very fragmented (close to a highly anthropomorphised region and organised in groups of variable sizes (3 to 10 individuals) and another not fragmented in a natural reserve. Cross breeding experiments between individuals from the two populations was carried out to find the level of decrease in consanguinity in descendants according to the geographical distance between the individuals. The following cross-breeds were realised: self-fertilization without human intervention, self-fertilization with human intervention, within-population crosses between neighbouring individuals, within-population crosses between distant individuals and between-population crosses. Addition crosses breeding between individuals from these Réunion populations and other individuals from a neighbouring island (Mauritius) were also carried out. Fitness components of descendants from these cross-breeds were measured (number of seeds per flower, weight of seeds, germination rate, growth, etc...). The most striking result of the study shows that there is no significant difference

between the descendants as a whole, except for those emerging from cross breeding between individuals originating from the same deme in the fragmented population. In these individuals, this cross breeding leads to the production of significantly weaker and smaller seeds than those produced by the non fragmented population.

M. Gosteli (Natural History Museum, Bernastrasse 15, CH-3005 Bern): Ecological relationships between snail communities and vegetation.

An inventory of the snail fauna was taken at 33 sample sites situated in four different habitat types near Merishausen in the northern Swiss Jura. To gain information about microclimate and soil quality in a given habitat plant communities and their ecological indicator values known from literature were scored at the sites. Snail faunas and plant communities are significantly correlated, indicating that ecological requirements of snails and plants occurring at the same site are similar. Both depend on microclimatic conditions as humidity, light, temperature and on soil factors as permeability, pH and nutrient content. However, the relatively low similarity coefficient of 0.5 between communities of snails and plants indicates that there may be other ecological factors (a biotic or biotic) influencing snails and plants in a different manner.

M. Haffner (Zoologisches Museum, Universität Zürich): Adaptations to digging and climbing in the sole of the feet of some small mammals.

The feet of nine species were studied by means of gross morphology and microscopical anatomy. Adaptations to digging and climbing were found in the integument and the claws. The palms of *Talpa europaea* are smooth. They have neither pads nor glands, for any elevation or moist surface would hinder the soil from rolling. Although *Arvicola terrestris* cuts soil with its incisors, the reduced number of foot pads, their flatness and the glandless sole indicate that the feet are used as shovel-like tools. Bats climb by hooking their long, curved claws into crevices and cracks. Foot pads are absent, but regions with a thickened epidermis reflect increased mechanical strain. *Rhinolophus ferrumequinum*, which is specialised in hanging on twigs while hunting insects, has epidermal thickenings at the soles of the middle phalanges of the toes. When *Myotis myotis* walks or climbs on horizontal surfaces the bearing part of the wing is the scutelliform-shaped integumentary thickening on the wrist, while in the hind feet the thickened soles of the first toes are mainly loaded. In *Micromys minutus* nap-shaped integumentary thickenings with eccrine glands at the base of the toes and around the carpal pads are adaptations to climbing by grasping stacks. *Muscardinus avellanarius* can climb by pressing the soles of its feet against the bark which is reflected by big softpads with a huge amount of eccrine glands.

B. Hägele & M. Rowell-Rahier (Zoologisches Institut der Universität Basel; Institut de Zoologie, Université de Neuchâtel): The choice and performance of two generalist and two specialist insect herbivores towards cacalol and seneciphyllin, a sesquiterpene and a pyrrolizidine alkaloid found in *Adenostyles alpina* (Asteraceae, Senecioneae).

Potential deterrent or attractive effects of two chemicals (cacalol, seneciphyllin and the combination of both) were tested in a first set of three experiments in standard leaf disk choice experiments. In a second set of experiments the same compounds were force fed to all species by painting them on leaf disks which were fed to the larvae over a period of ten to 15 days. The effects on the performance of the four species could be assessed by comparing the growth of the groups fed the leaf disks treated with the chemicals to those fed with disks treated with the solvent only. Larvae of the specialist leaf beetles *Oreina cacaliae* and *O. speciosissima* (Coleoptera, Chrysomelidae) showed neither an attractive nor a repellent reaction towards the

two chemicals when tested individually. The combination of both chemicals however was repellent to both species. Larval growth of the two leaf beetle species was not influenced by the experimental treatments. Larvae of the generalist *Cylindrotoma distinctissima* (Diptera, Tipulidae) were repelled by the cacalol, seneciphyllin and the combination treatment. Larval growth was reduced by all treatments except the alkaloid high concentration treatment. Caterpillars of the generalist *Callimorpha dominula* (Lepidoptera, Arctiidae) were repelled by cacalol and the combination treatment and not affected by the seneciphyllin treatment. After experience with seneciphyllin however it became attractive to the caterpillars. The high dose combination treatment was also effective in reducing growth of the caterpillars. Growth in all other treatments was not different from the control group.

L. Heer (Zoologisches Institut, Universität Bern): Intense sperm competition in the polygynandrous Alpine Accentor (*Prunella collaris*).

Alpine Accentors are breeding in groups consisting of 3–5 males and 2–3 females. All males of one unit compete for the access to fertile females within their breeding group. Of 7 females, focus animal samplings were performed to work out the role of females in controlling copulations. Alpine Accentors have a high copulation frequency and males do guard their mates closely to enhance their certainty of paternity. Females show fertility-advertisement by displaying themselves on elevated rocks and uttering long series of calls. Further, females actively seek out males what normally results in intense flight pursuits. The females are mainly responsible for soliciting copulations. Paternity is multiple in Alpine Accentors with up to three males siring young within one clutch. Results of DNA fingerprints indicate that frequent copulations and intense mate guarding do not ensure one male's full paternity in such a promiscuous system.

B. Hellriegel (Zoologisches Museum, Universität Zürich-Irchel, Winterthurerstr. 190, 8057 Zürich): Sperm competition in Diptera: adding the female perspective.

Sperm competition has traditionally been modelled exclusively from the male perspective: females have been taken as passive during the entire process. However, many female insects have a complex reproductive system which suggests a function in postcopulatory female choice to control or at least influence the paternity of their offspring. One of the traits constituting this complexity is the presence of multiple sperm stores: many female flies have two or three spermathecae.

The main purpose of this modelling approach is to determine the fertilisation success of different males under the assumption of postcopulatory female choice. The model mimics the essential features and possible functions of a reproductive tract with two (or more) separate sperm stores, which in principle enables the female to selectively store and use the ejaculates of different males. By comparing results of the mathematical model with experimental evidence, mainly from *Scatophaga stercoraria*, I address two questions: 1) Is there an advantage of having more than one spermatheca? 2) What are possible consequences of an uneven distribution of inseminations from different males between two (or more) separate spermathecae?

R. Hoess & A. Scholl (Zoologisches Institut, Universität Bern): The *Glomeris*-taxa *hexasticha* Brandt and *intermedia* Latzel (Diplopoda: Glomeridae): species or subspecies? – Allozyme data.

Diplopod species are usually distinguished by means of the gonopods of the males. *Glomeris* do not possess gonopods, and the telopods that males use to grasp the females' vulvae are similar in all species. Thus the color pattern of the tergites, often very variable, remains the only reliable feature for distinction. The taxa *hexasticha* and *intermedia* almost have the same color pattern and therefore are distinguished with reliability only by means of the form of the hind margin of the last tergite. Most myriapodologists presently consider *intermedia* as a

subspecies of *G. hexasticha* because of its vicariant distribution, even though in the beginning of this century Verhoeff raised it to species rank.

Based on a biochemical analysis using enzyme electrophoresis, we found very low genetic similarity between *hexasticha* and *intermedia*. Compared with three other clearly distinct *Glomeris* species, *G. intermedia* proved to be more closely related to *G. conspersa* and *G. transalpina* than to *G. hexasticha*. Both *G. hexasticha* and *G. marginata* are only distantly related to this trio. Consequently, *G. intermedia* must be treated as a bona-fide species.

R. Holderegger (Institute of Systematic Botany, University of Zürich, Switzerland): *Anemone nemorosa*: seed bank, germination and the effect of litter removal.

Anemone nemorosa L. is a dominant spring geophyte in the herb layer of different woodland communities in Central Europe. From the literature, seedlings are considered to be rare, germination rate to be low in (nature and in culture), recruitment to be irregular, and vegetative reproduction by clonal growth to be the main local dispersal agent. Litter removal experiments in a beech forest near Zürich, Switzerland, showed substantial germination of *A. nemorosa* in plots where litter has been removed as well as in control plots with litter. Litter removal strongly enhanced germination. A mean of 47.8 seedlings per square meter was found in plots where the litter was removed. A significant correlation between seedling number and ramet density within the plots implied dominant short-distance seed dispersal. Surprisingly, no diaspores of *A. nemorosa* could be detected in the seed bank. According to these results, sexual reproduction in the self-incompatible *A. nemorosa* may be as important as vegetative reproduction for the maintenance or increase of its local populations and in the determination of intrapopulational genetic structure. The genetic variation within populations of *A. nemorosa* will be investigated with isozymes electrophoresis.

C. Huber (Zoologische Aussenstation der Universität Zürich, Seestrasse 185, 8802 Kilchberg): Interspecific sperm competition in viviparous snails.

Until now, sperm competition was investigated exclusively within species. Especially when females mate with more than one male there is likely to be competition among the sperm for success at fertilizing the available eggs. This situation arises between species too, if two species hybridise in nature and females mate with males of both species. I investigated the possibility of interspecific sperm competition between the freshwater snail species *Viviparus ater* and *V. contectus*, which hybridise in Lake Garda, Italy. In previous crosses, virgin *V. ater* females mated to *V. contectus* males produced half as many offspring as intraspecific *V. ater* crosses, while the reverse combination was almost sterile. In my experiment I allowed 24 virgin *V. ater* females to mate once each with a *V. ater* and a *V. contectus* male, isolated the females and counted their offspring during 14 months. Hybrid offspring can be visually identified by the hair on their shells (*V. ater* offspring have none). Seventeen females produced 193 *V. ater* and 74 hybrid offspring. Three enzyme systems fixed for different alleles in the two species confirmed the visual identification of both *V. ater* and hybrids in 99% of all examined individuals. In the first two month, equal numbers of hybrid and *V. ater* offspring were produced. Then the number of both types of offspring declined, the decline being faster with hybrid than *V. ater* offspring. My interpretation of these results is that sperm competition did not occur, possibly because two matings did not provide enough sperm to ensure normal offspring production throughout the experimental period, and that *V. contectus* sperm can be equally successful in fertilising *V. ater* eggs as conspecific sperm.

M.J. Hutchings (School of Biological Sciences, University of Sussex, Falmer, Brighton, Sussex, BN1 9QG, UK): The role of heterogeneity in structuring clonal plant populations and plant communities.

The availability of essential resources is heterogeneous in space and time in most habitats. Despite this, measurements of the spatial and temporal scales at which resource provision is heterogeneous, and of levels of contrast of resource provision, are scarce. Information on the effects of habitat heterogeneity on the performance of plants has also been lacking until recently. Some of the information now available will be reviewed using studies of the clonal species *Glechoma hederacea*. It is now well known that *G. hederacea*, and many other plant species, are able to respond to heterogeneous resource distribution either through morphological or physiological plasticity, and that these responses can enhance resource acquisition and growth. Some of the effects of heterogeneous resource provision on performance will be illustrated, and predictions will be made about possible consequences for the composition of plant communities.

B. Imhoof & P. Schmid-Hempel (Experimentelle Ökologie, ETH Zürich): An endoparasite in a social insect: influence of the trypanosome *Crithidia bombi* on colony development of the bumble bee *Bombus terrestris* in the field.

Crithidia bombi is an endoparasite of bumblebees and is vertically transmitted within their colonies. Because it is horizontally transmitted between colonies and because it occurs in multiple infections inside one host it could afford to be very virulent, according to current standard theory. However, laboratory experiments comparing infected and uninfected bumblebee colonies revealed only mild effects, e.g. a delay in the production of males and young queens, but no reduction in number. In addition, *Crithidia bombi* did not affect the lifespan of bumblebee workers.

In the spring of 1995 I placed 16 colonies of *Bombus terrestris* infected in the lab and 16 uninfected colonies in three field sites. I monitored *Crithidia* infections in the faeces of the workers. All colonies became rapidly infected. Time to infection decreased over the season. There was no difference in the number of males and young queens produced in lab-infected or field-infected colonies, nor in the time span to their production after the placement in the field. The number of sexuals produced differed between locations. *Crithidia bombi* seems to be a parasite with very efficient transmission, but with very low virulence. In winter it is limited to vertical transmission by young queens. Therefore, the damage it can do to a colony is limited. It may even evolve towards mutualism to assure a sufficiently high production of young queens in infected nests.

P.M. Kareiva (Dept. of Zoology, University of Washington, 106 Kinkaid Hall, Seattle, WA 98195, U.S.A.): Detecting the consequences of global change: too many effects, too many causes and too few data.

As ecologists attack "big problems" such as landscape change or climate change, it is hard to know where to start. I will discuss a variety of approaches ranging from simulation models, to manipulative experiments, to long-term observations, to simplistic analytical theory. Each approach offers insights into the risks of habitat fragmentation and climate change, yet each also has severe limitations. I argue for using all approaches, and for being more ambitious in our efforts to address these pressing environmental problems using basic ecological theory. The organisms discussed will include Spotted Owls, pond-dwelling amphibians, endangered plants and animals in the United States, plant-insect-predator associations, and of course, "virtual organisms" in a computer.

L. Kohli, O. Daniel, F. Schönholzer & J. Zeyer (Soil Biology, Institute of Terrestrial Ecology, Swiss Federal Institute of Technology): Effect of the plant litter quality on the feeding rate of *Lumbricus terrestris*.

The effect of plant litter quality on a terrestrial food chain was investigated in a fallow (ecological compensation area) and in a plantation of the Japanese Pampas grass (*Miscanthus*

sinensis). Twelve different plant species were selected for the study and the food chain considered included plant litter --> bacteria/fungi --> *Lumbricus terrestris*. The content of polysaccharides (cellulose and non-cellulose) in the plant litter was quantified chemically and the growth of bacteria/fungi in the litter was followed by using specific staining techniques and automated image analysis. The feeding rates of *L. terrestris* were studied under field conditions and in microcosms.

Many plant species used in ecological compensation areas were suitable food resources for earthworms. The feeding rate depended on the plant species and was about 70% of the withdrawal rate. Field experiments with selected plants revealed a similar pattern of feeding and withdrawal. Feeding was positively correlated with bacteria in plants and negatively with cellulose content.

A. Krismann (Zoologisches Museum der Universität Zürich, Winterthurerstr. 190, 8057 Zürich): The suitability of moths to evaluate adjacent areas in different biotopes.

The use of moths by conservationists as bio-indicators is controversial because they are believed to fly long distances and so not to be habitat specific. I examined if the numbers of moth species and individuals differed between areas with different management regimes. I caught moths in 48 lighttraps in experimental exclosures and adjacent areas in a meadow and a pasture near the top of the "Schwäbische Alb" (southern Germany). The numbers of species and individuals differed significantly inside and outside the exclosures, especially for the Microlepidoptera. I also caught moths with light traps in a nearby forest, where the numbers of species and individuals was highest. The numbers were lowest in the meadow. Catches were also strongly positively correlated with maximum daytime temperature. This work suggests moths can be suitable bio-indicators to distinguish habitats. In a parallel study I compared arthropods caught in pitfalls and yellow bowls (Gelbschalen) in the same three habitats. They were equally useful in differentiating the habitats, in particular by identifying Hymenoptera.

S. B.M. Kraak & B. Mundwiler (Abteilung Verhaltensökologie, Universität Bern): Field data on the duration of egg collecting phase of the nesting cycle of the Three-spined Stickleback.

In 1953 van Iersel published a thorough causal study on the factors that induce the transition from courtship behaviour to parental behaviour in the male Three-spined Stickleback, *Gasterosteus aculeatus*. He found that at a certain moment in the nesting cycle, a male stickleback will stop courting additional females and collecting additional clutches of eggs, and will devote his time entirely to the care of the present brood until independence of the offspring. The relevant factors that were found to induce this transition are the number and the age of clutches in the male's nest. Recently, theoretical models have focused on the functional aspects of this transition. Since 1953, stickleback researchers have often cited van Iersel, when stating that male sticklebacks stop collecting eggs after 3 to 4 days. However, one must bear in mind that van Iersel's study was conducted in the laboratory under only a few, strictly controlled, conditions. We present for the first time data on the actual duration of egg collection by male sticklebacks in the field, under natural conditions. Not only did we find that the egg collection phase is often much longer than 3 to 4 days (up to 10 days), but also we found a large variation among males, and a decrease in the duration of the egg collection phase in the course of the breeding season. The variation in the duration of the egg collection phase will be discussed in the light of theoretical considerations.

C. Lang & O. Reymond (Conservatoire de la faune, Saint-Sulpice): Oligochaetes, organic sedimentation and trophic status: how to assess the biological recovery of sediments in lakes?

Oligochaete communities were used to assess the biological recovery of sediments after the abatement of eutrophication in Lake Geneva (Switzerland). In 1995, mean relative

abundance of oligotrophic worm species (OS) was around 30% in areas of low organic sedimentation (LOS) whereas, in areas of high organic sedimentation (HOS), it was below 15%. The abundance of OS observed in LOS areas was close to the value predicted from total phosphorus (TP) concentrations in the water. Accordingly recovery from eutrophication proceeded at the same place in the water (TP) and in the sediment (OS) of LOS areas, whereas it was delayed in the sediment of HOS areas. Lake Geneva was mesotrophic according to the oligochaete communities of LOS areas, but it was meso-eutrophic according to those of HOS areas.

C. Lavigne, X. Reboud & J. Gasquez (Institut für Umweltwissenschaften, Universität Zürich, Irchel), (Lab. de Malherbologie, INRA, BV 1540, 21034 Dijon cedex, France): Risk assessment of the release of herbicide resistant crops: importance of the cost associated with the resistance and its measurement in two crop species.

Applications for the commercial release of herbicide resistant crops, the majority of which transgenic, are becoming more and more frequent. The ecological concerns raised by their large scale use calls for risk assessment studies. By modelling the dispersal of such resistance genes with different genetic bases outside the field grown with the resistant crop, we show that the cost associated with the resistance (defined as the decrease in fitness of the resistant line compared to the susceptible one when no herbicide is applied) is the main parameter explaining the expected frequency of resistant plants outside the field.

Such a cost was tentatively measured in two crops, Foxtail Millet (*Setaria italica*) and White Chicory (*Cichorium intybus*) for which nearly isogenic susceptible and resistant lines were available. Resistance to atrazine was found to decrease the growth rate of the resistant line of Foxtail Millet whereas the sulfonylurea resistant line of Chicory did not differ significantly from the susceptible one. This suggests that this latter resistance gene would not be selected against if it escaped to populations of wild Chicories. The ecological consequences of our results will be discussed in relation to the biology of the species.

E. Mitchell, A. Buttler, J. Gobat, J. van Leeuwen, P. van der Knaap, B. Ammann & B. Warner (Botany Institute, University of Neuchâtel, Switzerland; Geobotany Institute, University of Bern, Switzerland; University of Waterloo, Ontario, Canada): Forest clearance in the early 19th century, an indirect cause for the present abundance of pine (*Pinus uncinata* ssp. *rotundata*) in the Jura bogs?

The important pine cover of most bogs in the Jura mountains is sometimes believed to be the result of a natural succession and therefore interpreted as a climax vegetation. However, pollen records show that the present abundance of pine is relatively recent and therefore appears to be artificial. Some authors suggested that these trees have been planted in the bogs or that they spread as a result of drainage, but the question is still debated. A multidisciplinary study was undertaken in the Praz-Rodet bog in the Vallée de Joux (Swiss Jura) using testaceans (Protozoa; Rhizopoda), plant macrofossil and pollen analyses. The results suggest that there is a long history of pine presence in the bog, but that until the early 19th century it was much less abundant than today. Pine spread over the bog after the surrounding forest was cleared to create new pasture. It is suggested that before that time, the bog was protected from summer hydric stress by the surrounding forest. Forest clearance suddenly exposed the bog much more to wind, which increased summer evapotranspiration, lowered the water table, and finally allowed pine to spread over the bog. Implications of this theory on bog conservation in the Jura are discussed.

A. Monsutti & N. Perrin (Institut de Zoologie et d'Écologie animale, BB, Université de Lausanne): Life-history responses to size-dependent predation in *Physa acuta* (Gastropoda).

Life-history theory predicts that an organism's resource allocation patterns should depend on extrinsic mortality factors. Adaptive response to changes in mortality regime may arise through either genetic evolution or phenotypic plasticity.

To investigate these topics, we subjected experimental populations of the freshwater snail *Physa acuta* to different mortality patterns. One predator (*Macrostomum* sp.) feeds only on small juveniles (up to 2 mm). Theory in this case predicts a shift in prey life-history towards larger offspring. The other predator (*Dugesia polychroa*) feeds on adult snails as well, but only up to 6–7 mm. In this case, theory predicts shifts towards both larger offspring and larger adults. These precise shifts were observed in the experimental populations within 3 months of coexistence with predators.

Macrostomum presence induced a shift towards larger eggs, but did not affect *Physa* adult size. By contrast *Dugesia* induced shifts towards both larger adults and larger eggs. Since some of these responses to predation might be indirect, we performed analyses of partial effects as well as density-manipulation experiments. Predator presence remained the most significant factor responsible for the observed shifts. We conclude that *Physa acuta* can adjust on a plastic basis important life-history traits to the presence of different types of predators.

L. Passera, E. Roncin, B. Kaufmann & L. Keller (Universités de Lausanne et Berne): Increased soldier production in ant colonies exposed to intraspecific competition.

The most familiar examples of the advantages arising from division of labour and caste differentiation come from social insects. It has been suggested that the proportion of workers of various physical castes has evolved to enhance the fitness of colony members with the prediction that caste ratios should vary with environmental factors such as predation, competition and food availability. We experimentally tested this prediction in the ant *Pheidole pallidula* by comparing soldier production between colonies in which workers perceived the presence of foreign-colony workers and control colonies with no contact between foreign colonies. As predicted by caste ratio theory *P. pallidula* colonies increased soldier production in response to the presence of foreign workers. This is the first experimental evidence of a social insect altering physical caste ratios in relation to environmental factors.

J. Perritaz, A. Grub & H. Müller-Schärer (Institut de biologie végétale/écologie, Université de Fribourg; Eidg. Forschungsanstalt Liebefeld, Bern): Conservation of endemic wheed flora in Winter Wheat: comparison of weed- and wheat-development between acid and alkaline soils.

The studied strip management involves the conservation of a strip of 6 m to 12 m in width along the border of crop fields, where no herbicide and fertiliser treatments are applied. It constitutes a type of ecological compensation recommended in Integrated Production system in Swiss agriculture, aiming at the enhancement of species biodiversity by conserving the endemic flora of companion plants ("weeds") in crops. Fourteen fields of winter wheat of varying soil pH where selected in the canton of Fribourg (CH) and in each field, a control (common agricultural practice) and a strip treatment (with no herbicide and fertiliser) were applied in a plot of 6 m x 12 m. Number of plant species and number of individuals were greatly increased by 400% and 300%, respectively, in the strip plots as compared with the control plots, but weed biomass was only increased by 200% resulting in a 50% reduction of crop biomass. Number of plant species emerging from soil samples were positively correlated with the observed number of weed species in the strip plots. Here, the number of individuals, but not of species, was

significantly higher in acid soils ($\text{pH} < 6.0$) as compared with alkaline soils ($\text{pH} > 6.0$). Thus with regard to augmenting species biodiversity, both soils types are equally suitable, but weed pressure (biomass) is expected to be lower on alkaline soils.

I.R. Sanders, M. van der Heijden, R. Streitwolf-Engel, T. Boller & A. Wiemken (Botanisches Institut, Universität Basel): Arbuscular mycorrhizal fungi as driving forces of plant population and community structure.

Arbuscular mycorrhizal fungi (AMF) grow on the roots of 90% of vascular plants, with which they form mutualistic symbioses. Although AMF have already been shown to improve plant growth and to be strong determinants of floristic diversity, little attention has been given to understanding the ecological effects of different AMF species (or types). Studies comprising part of the Swiss Biodiversity Programme have focused on the effects of different species of native AMF on life histories, and reproductive strategies in plants and, consequently, as determinants in the structuring of plant communities. Our results from several studies combined suggest that: 1. Colonisation by different AMF isolates can alter the reproductive strategy of some plant species, in some cases affecting whether a plant is likely to reproduce clonally or sexually. 2. That plant species differ in how they will respond to different AMF isolates and that for some plants AMF diversity could be more important in determining the population structure than in other species. 3. That AMF diversity should be a strong determinant of plant community diversity in terms of the species composition and community structure and in the diversity of populations making up the community.

A. Sierro (Swiss Ornithological Institute, Sempach): Foraging activity and diet of *Caprimulgus europaeus* in Valais, South Switzerland: implication for conservation and landscape management.

Foraging by Nightjars away from their nesting areas has already been observed in the south of England. The birds preferred deciduous or mixed woodland habitats, while they avoided conifer plantations and arable or improved grassland.

In central Valais, similar observations have now been made in a pine wood in the immediate vicinity of vineyards. In 1994, 3 male Nightjars were fitted with glue-on radiotransmitters during Spring and early Summer. Each bird was followed from two fixed antennas during 5 to 13 nights; their locations were recorded every 5 minutes. In order to understand the significance of these regular flights away from the forest, three light traps were installed to catch flying insects at different locations from early June to mid August. The three main habitats, open woodland, hedgerows, and intensively cultivated vineyards were chosen. The discovery of a nest allowed the taking of 16 food samples brought by the adults to one nestling. The results showed a clear preference for open woodland (61.3% of locations) and steppes or hedgerowed cultures (31.4%). Nightjars clearly avoided intensively cultivated vineyards, even if some sightings were made over this habitat (5.6%). 1.7% of sightings were recorded in artificial environments. The home range of the unmated male was much larger than those of the two mated males. The farthest records of displacement were more than 2 km. The bulk of the diet consisted of Lepidoptera (83%), Neuroptera (14%), Diptera (2%). The most visited habitats were related to the richest food availability. However, the hedgerowed vineyards were less visited, while they are often richer than the woodlands. The trapping methods of insects are probably responsible for this bias. The nightly visits to the hedgerowed vineyards highlight the necessity of revitalisation of the most intensively cultivated areas and a global protection concept for Nightjar conservation.

N.C. Stenseth (Department of Biology, University of Oslo, P.O. Box 1050 Blindern, N0316 Oslo, Norway): Regional determinants of vole population cycles in Northern biomes.

The paper focuses on the population dynamic patterns of northern vertebrate populations as deduced from time series data on abundances. The deduced temporal patterns are

interpreted on the basis of general ecological models. A general discussion is first presented where it is argued that the population dynamics of vertebrate populations are either only regulated from above or both from above and below; they are never likely to be regulated only from below unless the region is too arid for a predator level to exist. This is argued to be unlikely for the boreal system. Three vertebrate systems in the boreal zone are discussed:

1. The small rodent population cycles in Fennoscandia: North of 60 degree, cycles are found in all studied microtine populations. As going north from 60 degree, the length of the cycle as well as the amplitude of the cycle increases. In statistical terms, this gradient is appropriately described by a clinal gradient in the first order autoregressive parameter (of a second order log-linear autoregressive model). The cyclic nature of the microtine rodents are argued due to specialist predators such as mustelids; the clinal structure in Fennoscandia is argued due to a gradient in the abundance of generalist predators. That is, a predator-prey model is assumed appropriate and the microtine rodents in Fennoscandia are argued to be regulated from above.

2. The grey-sided vole in the northernmost part of Hokkaido: Data from 90 populations are discussed (this being a subset of a much larger set); these populations are all found in the boreal zone. A gradient from the western coast to the mountains in the interior part of the island is found – along the coast only seasonal fluctuations are found whereas multiannual cycles (of the kind seen in Fennoscandia) is found. This population dynamic gradient is due to a clinal gradient in the second order autoregressive parameter; this is furthermore argued due to changing snow cover (with more and longer snow cover in the mountainous interior part of the northernmost part of Hokkaido). Again, a predator-prey model (and regulation from above) is argued to be appropriate; however, even though the geographic pattern in the population dynamic characteristics are superficially similar to those seen in Fennoscandia, the causes of the observed biogeographic patterns in Fennoscandia and in Hokkaido are argued due to different processes (generalist predators and snow cover, respectively).

3. The snowshoe hare and lynx dynamics (as seen in the Canadian boreal zone): It is shown that the dynamics of the snowshoe hare is appropriately seen as a three dimensional process (where the hare dynamics is controlled both from below and above), whereas the lynx is appropriately seen as a two dimensional process (where the lynx dynamics is controlled only from below – the top predators presumably being too scarce to be of any major influence). Ecological models developed on the basis of the statistical analyses are found consistent with available data (including experimental data).

The paper is concluded by a discussion of the importance of environmental stochasticity in northern ecosystems (such as the boreal forests). This is done in the framework of a discussion of the relative importance of non-linearity and environmental stochasticity: If the process is strongly non-linear, environmental stochasticity is not necessary in order to sustain the population cycles seen in northern ecosystems. However, if the process is not strongly non-linear, then the deterministic part of the system (primarily determined by biotic interactions within the system) may be seen to determine the periodicity of the periodic fluctuations whereas the environmental stochasticity (e.g., perturbations due to factors such as weather) may be seen as the factor sustaining the cyclic nature of the population dynamics.

As a side issue, the issue of chaos is in this connection touched upon: it is suggested that – consistent with the results of testing for non-linearity – there is no clear indication of chaos in the northern vertebrate populations discussed above. This is partly shown by calculating confidence intervals for point estimates of the dominant Lyapunov exponents for the analysed time series. The same conclusion is also reached by another avenue studying the cyclic process as such.

As a post script, some reflections are advanced in the form a general discussion of the need for combining the study of patterns (as deduced from long term time series data) with the study of processes (as, e.g., deduced from experimental studies). Indeed, it is argued that experimental and theoretical ecology must be combined with natural history type of approaches. It is finally argued that this merging most efficiently is done by combining statistical modelling and mathematical modelling. Examples of this is given throughout the paper.

H.B. Stutz (Zoologisches Museum, Universität Zürich): Population estimates of *Myotis myotis* in Switzerland.

Over a period of six years (1990–1995) the maximal number of adult individuals (mainly females) was estimated for 60 maternity roosts of *Myotis myotis*/*blythii* in the eastern parts of Switzerland. From May to mid-July, bats were counted at daytime while roosting or at dusk when emerging from their roosts. To estimate the whole population of *Myotis myotis*, the following unknown factors, besides the comparability of counting methods, have to be taken into account: the number of individuals of the sibling species *Myotis blythii* in approximately 10% of the maternity roosts, adult males outside the maternity roosts, unknown maternity roosts, exchange of individuals with colonies outside the study area. Estimating these factors by means of hypotheses derived from literature and taking into account the mean values of the years '93, '94, '95, a total number of approximately 21'500 adult individuals of *Myotis myotis* can be calculated. In comparison to similar population estimates of *Myotis myotis* in some parts of Germany, the Swiss population density is only half this size. But altitude distribution of *Myotis myotis* in relation to the specific topographic situation in the eastern parts of Switzerland could highly influence our estimate.

M. Tschan, A. Aebischer & D.R. Meyer (Institute of Zoology, University of Fribourg): Is food availability related to territory quality or breeding success in the Savi's Warbler?

The Savi's warbler (*Locustella luscinioides*; Sylviidae) winters in West Africa. The breeding site under investigation is 17 ha and consists of continuous, inundated reed and sedge stands; it is situated at the Southern shore of Lake Neuchâtel. A discriminant analysis based on eleven parameters of vegetation structure was performed in order to find the canonical function that provides the best segregation between territories, and pseudo-territories randomly generated on paper. The score on the axis of the discriminant function correlated negatively with the male/female arrival date and positively with male/female breeding success. (Aebischer *et al.* 1996). The food availability in the territories (insect larvae and freshly metamorphosed adults of water insects) was measured by collecting all invertebrates on small plots. It does not correlate with territory score nor with the arrival dates of males.

We erected observer platforms to survey the foraging excursions of selected birds feeding young. We noted that 78% of all excursions (always on the ground) lead outside their proper territory, into nonoccupied land. Video monitoring of nests and analysing neck ring probes revealed that for the first brood 55% of the fed biomass consists of freshly hatched dragonflies, later in the season the warblers become more generalist in behaviour. The biomass fed per hour per young decreases slightly with the season, the feeding frequency increases.

T. Turlings (Institute of Plant Sciences, Applied Entomology, ETH Zürich): Do herbivore-damaged plants protect themselves by attracting parasitic wasps?

Plants that are under attack by herbivores initiate the release of highly specific volatiles. The emissions of these plant volatiles result in an odor that is used by natural enemies of the herbivores to locate the damaged plants. Recent studies have shown that parasitic wasps make effective use of these odors. It is tempting to suggest that the plants emit the odors to lure in the parasitoids and predators for their protection. If indeed the plants emit an odorous signal to broadcast the presence of herbivorous insects to natural enemies of the herbivores, such a signal would be particularly effective if: 1) The signal is easily detected by parasitoids and clearly distinguishable from background odors. 2) The signal is specific enough that it would enable the parasitoids to recognize plant damage that is done by suitable hosts. 3) The emission of the signal occurs shortly after the herbivore starts feeding and is emitted at the time that the natural enemies forage. Evidence that support or contradict these three criteria for an useful signal will be presented. The controversy concerning the function of herbivore-induced emissions of plant volatiles will be further discussed.

C. Wedekind & M. Milinski (Abt. Verhaltensökologie, Zoologisches Institut, Universität Bern, 3032 Hinterkappelen): Do sticklebacks avoid consuming copepods, the first intermediate host of *Schistocephalus solidus*? – An experimental analysis of behavioural resistance.

Many parasites that use intermediate hosts are transmitted to the next host through predation. If the next host's fitness is strongly reduced by the parasite, it is under selection either to recognize and avoid infected intermediate hosts or to exclude that prey species from its diet when alternative prey are available. We investigated the predator–prey interaction between laboratory bred Three-spined Sticklebacks (*Gasterosteus aculeatus*), the second intermediate host of the cestode *Schistocephalus solidus*, from two parasitised and one unparasitised population, and different prey types: infected and uninfected copepods and size-matched *Daphnia* as alternative prey. Copepods with infective procercoids were more active, had a lower swimming ability and were easier to catch than uninfected controls. The sticklebacks preferred moving copepods. Therefore parasitised copepods were preferentially attacked and consumed. There was no effect of the sticklebacks' parent population being parasitised or not. The sticklebacks switched from *Daphnia* to (uninfected) copepods in the course of a hunting sequence; this switch occurred earlier in smaller fish. With this strategy the fish maximised their feeding rate: *Daphnia* were easier to catch than copepods but increasingly difficult to swallow when the stomach was filling up especially for smaller fish. However, there was no indication that sticklebacks from infected populations either consumed *Daphnia* rather than copepods or switched later in the hunting sequence or at a smaller size to consuming copepods than fish from an uninfected population. Thus, sticklebacks did not avoid parasitised prey although *S. solidus* usually has a high prevalence and causes a strong fitness reduction in its stickleback host.

M. Weggler (Zoologisches Institut, Universität Zürich): Why do some males look like females in passerine birds?

Male passerine birds of several species adopt for their first breeding season a dull-coloured, female-like plumage. Delayed plumage maturation is viewed as an adaptation to enhance breeding success and/or survival of sexually mature but still inexperienced males. Female-coloration in males could either function as a dishonest signal (female mimicry) to gain access to breeding opportunities or copulations deceptively. Alternatively it could work as an honest signal to avoid aggression in territorial combats (aggression avoidance) or it could simply be a moult constraint without measurable fitness consequences. I tested these hypotheses using the Black Redstart *Phoenicurus ochruros* as my study organism. A bimodal morph distribution in first year males with males either indistinguishable by sight from females or males that look like adult males provides the unique possibility to separate effects of age from effects of coloration in this species. Preliminary results analysing primary and secondary reproductive success of an alpine population studied for two consecutive years do not favour the female mimicry hypothesis.

A. Widmer & P. Schmid-Hempel, A. Estoup & A. Scholl (ETH Zürich, Institut für experimentelle Ökologie; Laboratoire de Génétique des Poissons, INRA, France; Zoologisches Institut, Universität Bern): Genetic differentiation and gene flow in the pollinators *Bombus pasquorum* and *B. terrestris* (Hymenoptera).

Levels of genetic differentiation among populations are the result of both historical and present day processes. Historically, cycles of glacial and interglacial periods have repeatedly disrupted formerly continuous distributions. Populations survived cold periods in isolated refugia from where recolonisation occurred. These processes have had major impact on the amount and distribution of genetic variation within and among populations. Whether these historical traces are still evident in present-day populations mainly depends on the level of gene flow and drift. We studied the genetic population structure of two pollinators, the bumblebees

Bombus pascuorum and *Bombus terrestris*, using microsatellite markers. We found that the levels of genetic differentiation among European populations strongly differ in the two species. We discuss these results with respect to historical and present-day scenarios.

A. Wust-Saucy (IZEA, University of Lausanne, 1015 Lausanne): Phylogeography and genetic differentiation of the ecological forms of the water vole, *Arvicola terrestris*, in Europe.

Arvicola terrestris is a highly polymorphic species with a wide geographic distribution covering most Eurasia. The many (more than 35) subspecies described by taxonomists can be grouped according to their ecology into semi-aquatic and fossorial forms. The significance of these two forms, which are differentiated by characters such as body size, colour, weight, population dynamics, home range size, mating behaviour and habitat, is still controversial. The sequencing of the cytochrome b gene of the mitochondrial DNA shows a genetic divergence between the two ecological forms of *Arvicola terrestris*. Furthermore the phylogenetic analyses describe the fossorial populations as monophyletic whereas the aquatic ones as polyphyletic. Eventually the study of the European phylogeography of this species allows us to propose some historical hypotheses to explain its present distribution.

Synusial structure of heathlands at the subalpine/alpine ecocline in Valais (Switzerland)^{1, 2}

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Synusial structure of heathlands at the subalpine/alpine ecocline in Valais (Switzerland). - In order to assess the impact of predicted climate changes in the next future, the floristic and synusial structure of heathlands were studied along two altitudinal transects at the subalpine and alpine levels in the Alps of the Valais. The first, south-east oriented transect is dominated with thermophilous, low heaths of *Arctostaphylos uva-ursi* (L.) Sprengel. The second, east oriented transect is dominated with mesophilous, taller heaths with *Rhododendron ferrugineum* L., *Vaccinium myrtillus* L., *V. uliginosum* subsp. *microphyllum* (Lange) Tolm. Both ecosystems show a thermal inertia but they will not react in the same way to climate change because the thermophilous heaths are mainly driven by temperature and the mesophilous heaths by snow cover.

Key-words: Alps - Climate change - Heath - Plant community - Subalpine - Alpine - Synusiae.

INTRODUCTION

In the near future, global climatological models predict an increase of mean global temperatures of 1.5-4.5 K with a doubling of the CO₂ concentration in the atmosphere (HOUGHTON & *al.*, 1990, 1992). In order to assess the impact of this predicted climate change on the vegetation at the subalpine/alpine ecocline, the floristic and synusial structure of heathlands were studied along two altitudinal transects on siliceous rocks in the Alps of the Valais.

The first transect, where thermophilous, low heaths of *Arctostaphylos uva-ursi* (L.) Sprengel and *Calluna vulgaris* (L.) Hull are predominant, is located in the Val d'Arpette (Orsières) on a steep, rocky, south to south-east oriented slope, ranging from 1720 to 2814 m asl. The steep slopes of this site prevent any accumulation of large

¹ The present study is part of the project "Reaction of the vegetation to climate change in the subalpine/alpine ecocline" of the Priority Programme Environment of the Swiss National Science Foundation (Grant 5001-35341).

² Main lecture presented at Zoologia and Botanica 96.

quantities of snow, and the southern aspect induces a rapid snowmelt in early spring, particularly when spring snow precipitation has been low. According to our observations, the difference in the date of snowmelt from plots at the bottom of the transect and those at the limit of the upper heath communities (around 2500 m asl.) does not exceed one week.

The second transect, dominated with mesophilous, taller heaths with *Rhododendron ferrugineum* L., *Vaccinium myrtillus* L., *V. uliginosum* subsp. *microphyllum* (Lange) Tolm., and *Empetrum nigrum* subsp. *hermaphroditum* (Hagerup) Böcher, is located in the Aletsch region (Naters) on a more gentle, east oriented slope, ranging from 1900 to 2855 m asl. Contrary to the Val d'Arpette, there is an important snow cover in Belalp. Therefore, there is a difference of about three to four weeks for the date of snowmelt in the spring between the bottom of the transect and the top of the heaths at 2400-2500 m asl.

METHOD

According to the Braun-Blanquet method (BRAUN-BLANQUET, 1932, WESTHOFF & VAN DER MAAREL, 1980), 77 phytosociological relevés (vegetation samples) (44 at the Val d'Arpette and 33 at Belalp) were carried out. Within the same plots, 539 synusial relevés were conducted (310 at the Val d'Arpette and 229 at Belalp). The synusiae were defined according to four main parameters: biological types, stratification, horizontal distribution, and seasonal replacement of the species. In this respect, synusiae group together plants having more or less the same strategy in their development, and in their ecological requirements. They represent ecological and organisational compartments of the community (BARKMAN, 1980; WALTER, 1984, 1985).

The Braun-Blanquet relevés of heaths were classified into 17 plant communities, and the synusial relevés into 84 types of synusiae. Classification was performed with the help of the package for multivariate analyses MULVA 5 (WILDI, 1991, 1994).

RESULTS

Figure 1 shows the distribution of the different types of synusiae according to elevation at the Val d'Arpette. The synusiae appear to behave as two different systems, a lower subalpine and an upper subalpine system respectively. These two systems intergrade into each other gradually, but there is a clear discontinuity between 2000 and 2100 m where the lower subalpine synusiae disappear and most of the upper subalpine synusiae appear. This break appears to be related to a change of the slope at the tree line, the slope being less steep above.

Figure 2 shows the results for the Belalp site. Here, the synusial structure presents a great altitudinal uniformity amongst four synusiae, including the two most important ones. However, there is a regular, stepwise change in the composition of other synusiae with elevation.

DISCUSSION

In considerations of alpine climate, temperature and snow cover are the two main factors to be considered in high mountains at mid-latitudes, where temperature decreases regularly with elevation (0.55 K/100 m) (e.g. OZENDA, 1985). Snow cover is important in protecting plants against frost (e.g. LARCHER, 1994), and both temperature and snow cover determine the length of the vegetation growth period (e.g. ELLENBERG, 1986, 1988).

The early disappearance of snow in the spring on the southern slopes in the Val d'Arpette determines a relatively long vegetation growth period but, as a consequence, vegetation is poorly protected against late frost. Therefore, most dominant species of the prevalent synusiae are thermophilous but frost resistant species, such as *Arctostaphylos uva-ursi* (L.) Sprengel, *Juniperus communis* subsp. *alpina* (Suter) Celak, *Calluna vulgaris* (L.) Hull and *Festuca scabriculmis* subsp. *luedii* Mgf. - Dbg. Moreover, the structure of this vegetation forms a real "slipping plane" which helps snow slipping and snow creeping. Under climatic conditions which manifest only an increase in temperature, the lower subalpine synusiae will probably slowly invade higher elevations and push upwards, or even eliminate some of the upper subalpine synusiae, especially in the case of the highest predicted increase in temperature. This may happen with some inertia due to the delayed reaction of the plant species (e.g. persistence, dispersal), extreme climatic events, and the influence of the relief, in particular the slope between 2000 and 2100 m asl (THEURILLAT & *al.*, in print). These predicted changes may not be very dramatic because generally speaking, the heaths are floristically relatively homogeneous, in particular in the dominant synusiae, despite their important altitudinal range. Indeed, often the same species shifts from one synusiae to another, from the bottom to the top of the transect. For example, *Arctostaphylos uva-ursi* is dominant in the lower subalpine *Arctostaphylos/Vaccinium myrtillus* synusia, and it is also dominant in the upper subalpine *Arctostaphylos/Vaccinium uliginosum* synusia, in which *Vaccinium myrtillus* is still present. Thus, in the Val d'Arpette, temperature appears to be the main factor determining the composition and the structure of heaths, whereas snow appears to be of secondary importance in this respect, and a reduction in the snow cover may probably not greatly affect the heath formation, because of its frost resistance.

In contrast, the heath structure at Belalp seems to be mainly determined by the quantity of snow cover, with mesophilous, late frost sensitive species, such as *Rhododendron ferrugineum* L., *Empetrum nigrum* subsp. *hermaphroditum* (Hagerup) Böcher, and *Vaccinium myrtillus* L., but also a gradual stepwise replacement of some synusiae by others. The even distribution of the dominant synusiae independent of elevation shows that an increase in temperature alone will not modify these synusiae. However, with a longer vegetation growth period resulting from temperature increase, these synusiae will be able to slowly invade the alpine meadows. However, if there is a concomitant decrease in winter precipitation, in particular of snow, the reduced snow cover which will result may no longer provide adequate protection to the sensitive, structurally predominant species. These species could thus be severely

ARPETTE

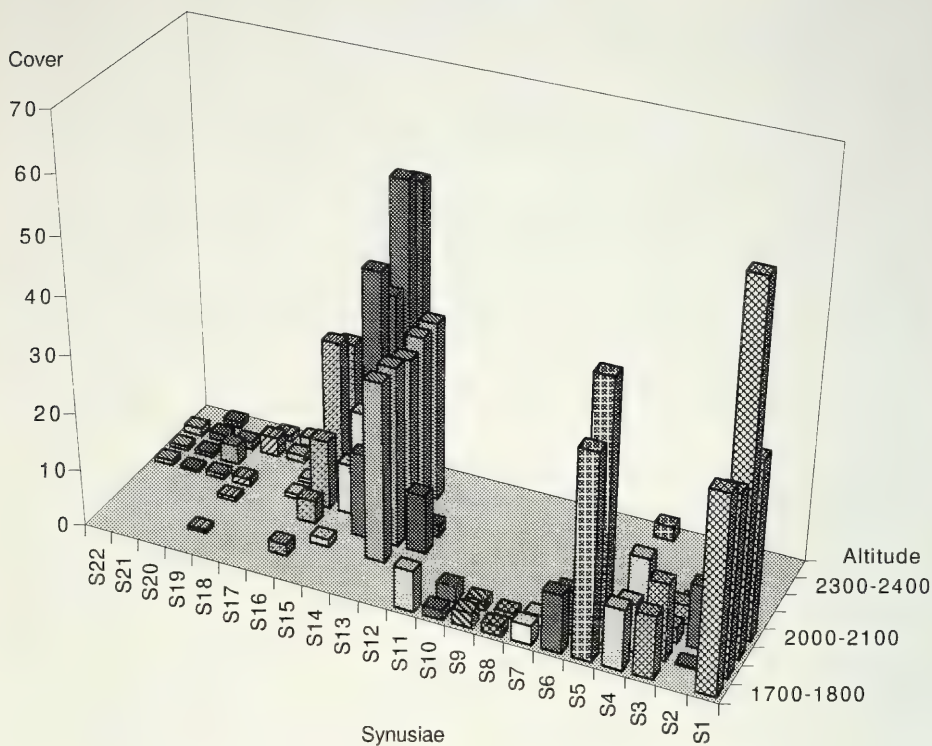


FIG. 1

Cover of the main heath synusiae (S1-S22) relative to elevation (expressed in altitudinal sections of 100 m) at the Val d'Arpette. Main synusiae: S1 = synusia of *Arctostaphylos uva-ursi* and *Vaccinium myrtillus*; S5 = synusia of *Vaccinium myrtillus* and *V. vitis-idaea*; S13 = synusia of *Arctostaphylos uva-ursi* and *Vaccinium uliginosum* subsp. *microphyllum*; S14 = synusia of *Vaccinium myrtillus* and *V. uliginosum* subsp. *microphyllum*; S16 = synusia of *Festuca scabriculmis* subsp. *luedii* and *Carex sempervirens*.

affected by such a situation, especially at lower elevations, and this could lead to a dramatic change in the species composition.

CONCLUSION

The natural climatic gradient which occurs in mountains appears to be an ideal tool to investigate the effects of climate change on the vegetation in high mountains. If the synusial gradient observed with altitude is truly correlated with a climatic gradient, the synusial structure of the vegetation provides the possibility for the assessment of the impact of climatic changes. In this respect, the synusiae appear to be more finely tuned than the whole plant communities.

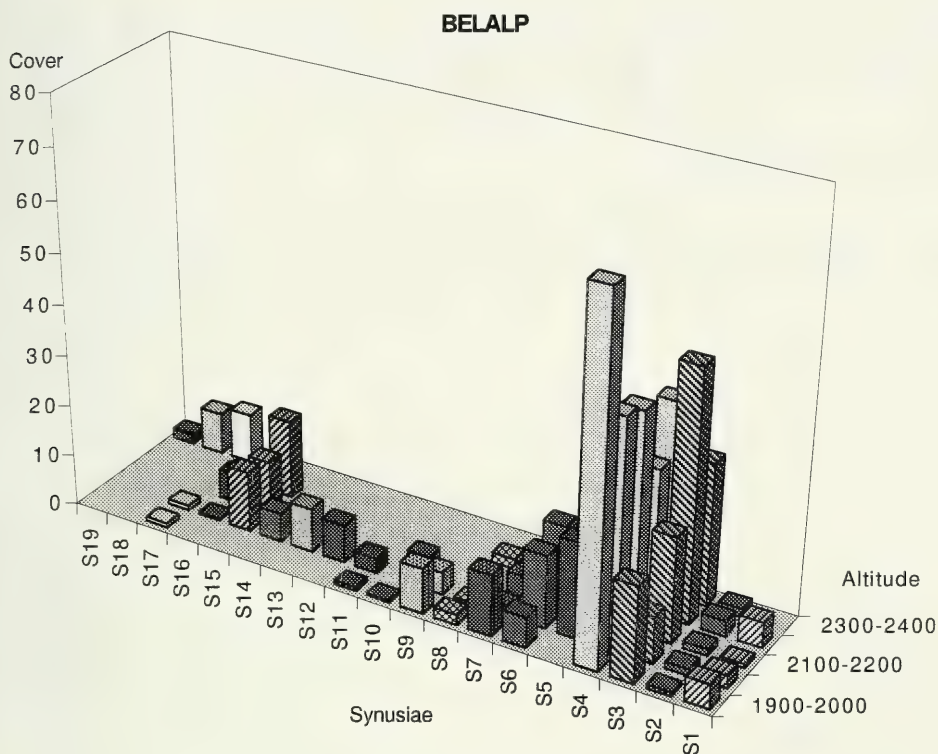


FIG. 2

Cover of the main heath synusiae (S1-S19) relative to elevation (expressed in altitudinal sections of 100 m) at Belalp. Main synusia: S1 = tall chamaephyte synusia of *Rhododendron ferrugineum*; S2 = synusia of *Homogyne alpina* and *Geum montanum*; S3 = synusia of *Loiseleuria procumbens* and *Vaccinium uliginosum* subsp. *microphyllum*; S4 = synusia of *Empetrum nigrum* subsp. *hermaphroditum* and *V. uliginosum* subsp. *microphyllum*.

The structure of the subalpine heaths is determined mainly by a few dominant clonal ericaceous species (including the *Empetraceae*), which are almost independent of community types once a preliminary distinction of thermophilous, mesophilous and cryophilous ecosystems is made. Thus, there are two dominant synusiae, independent of elevation in the mesophilous ecosystem of Belalp, and two systems of three to four dominant synusiae related to altitude in the thermophilous ecosystem of the Val d'Arpette. Both ecosystems show a thermal inertia which, at most, is equivalent to their altitudinal amplitude (ca. 600 m), that is ca. 3.3 K at their highest elevations. However, these two ecosystems will not react in the same way to climate change because the thermophilous heaths are mainly driven by temperature and the meso-

philous heaths by snow cover. Therefore, a climate change involving a reduction of snow cover may act more on mesophilous heaths, because of their sensitivity to frost, than on thermophilous ones.

ACKNOWLEDGEMENTS

We are very grateful to Loraine Kohorn, Duke University, Durham, NC, for the linguistic revision, and to Prof. R. Spichiger for the facilities provided at the Conservatoire et Jardin botaniques of the city of Geneva.

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Variation in species richness of plants and diverse groups of invertebrates in three calcareous grasslands of the Swiss Jura mountains

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Variation in species richness of plants and diverse groups of invertebrates in three calcareous grasslands of the Swiss Jura mountains. -

Species richness and abundance of vascular plants and several groups of invertebrates (spiders, oribatid mites, diplopods, grasshoppers and bush crickets, ground beetles, butterflies and terrestrial gastropods) were recorded in three calcareous grasslands (Nenzlingen, Movelier and Vicques) in the northwestern Swiss Jura mountains. Species richness varied both between taxonomical groups and between sites (species richness ranges: 96-116 vascular plants, 60-66 spiders, 18 oribatid mites at each site, 1-7 diplopods, 10-16 grasshoppers and bush crickets, 19-21 ground beetles, 32-46 butterflies and 15-21 terrestrial gastropods). Species overlap (number of species that occurred at all sites) was relatively large in terrestrial gastropods (59.1%), butterflies (56.5%), vascular plants (53.8%) and grasshoppers (47.1%), but relatively low in oribatid mites (32.3%), spiders

(25.0%), ground beetles (18.4%) and diplopods (12.5%). Diversity expressed by the Shannon-Wiener index (H') was compared for five groups of invertebrates. Diversity was largest in spiders and ground beetles and lowest in terrestrial gastropods. Different taxonomical groups had their maximum diversity at different sites: each grassland had the highest diversity in at least one group. The three sites also varied in the abundance of different invertebrate groups. Most groups had the highest densities in Nenzlingen and the lowest densities in Vicques. All three sites contained a high proportion of species listed in the Red Data Book of Switzerland with values averaging 49.5% in grasshoppers and bush crickets, 28.9% in butterflies, 18.9% in vascular plants, 11.2% in terrestrial gastropods, and 6.7% in ground beetles. One spider species (*Oxyptila pullata*) and two mite species (*Epilohmannia cylindrica minima* and *Pergalumna myrmophila*) were recorded for the first time in Switzerland.

Key-words: Acari - Araneae - Biodiversity - Calcareous grassland - Coleoptera - Diplopoda - Gastropoda - Lepidoptera - Orthoptera - Vascular plants.

INTRODUCTION

Many human activities, such as intensive agriculture, urbanisation, deforestation, and the building of roads and railways reduce natural habitats to remnants of different sizes. In addition to the overall decrease in the area available for the organisms, the fragmentation of habitats leads to a division of existing populations into isolated subpopulations of small size and to changes in habitat characteristics in the fragments (SOULÉ 1986, SAUNDERS *et al.* 1991). It is generally assumed that habitat fragmentation contributes significantly to the local extinction of animal and plant species (SAUNDERS *et al.* 1991).

In the northwestern Jura mountains, unfertilized calcareous grasslands were large and continuous at the beginning of this century, but since the 1950's changes in agricultural practices such as the use of modern machinery, chemical fertilizers, herbicides and pesticides, and new breeds of plants have reduced the size of these areas and split them into small and isolated fragments. For example, between 1950 and 1985 the total area of unfertilized calcareous grassland was reduced by 78% in the Passwang region in northwestern Switzerland (ZOLLER *et al.* 1986). This overall reduction of the unfertilized grassland area and the isolation of the remnants may have led to a dramatic loss of species within a short period.

In 1993, a multidisciplinary coordinated project was started to experimentally analyse fundamental aspects of biodiversity using dry grasslands on calcareous soils in the northwestern Swiss Jura mountains as an exemplary model (LESER 1994, BAUR & ERHARDT 1995). Most of the field work is done at three sites (Nenzlingen, Movelier and Vicques). The present paper examines species richness and abundance of vascular plants and various groups of invertebrates (spiders, oribatid mites, diplopods, grasshoppers and bush crickets, ground beetles, butterflies and terrestrial gastropods) in

these grasslands. In particular, we address the following questions: (1) Do the three grasslands differ in plant and invertebrate species richness? (2) Are there any associations between the species richnesses of different taxonomical groups? (3) Do different taxonomical groups differ in species overlap at the three sites? (4) Do the three sites differ in the overall density of particular taxonomical groups? and (5) Do the three sites differ in number and proportion of rare and/or threatened species?

STUDY SITES AND GENERAL METHODS

The three field sites are nutrient-poor, dry calcareous grasslands (belonging to the Teucrio-Mesobrometum type; ELLENBERG 1988) situated near Nenzlingen (10 km S of Basel), Movelier (5 km N of Delémont) and Vicques (5 km E of Delémont). The three sites are situated within 20 km of each other.

There are local differences between the three sites. The study site in Nenzlingen (1.5 ha in size) is situated on a SW-facing slope with an inclination of 19-22° at an altitude of 500 m a.s.l. A deciduous forest borders the investigation area to the NE. Annual precipitation averages 991 mm in Grellingen (3 km E of the study site). Soil properties and soil profiles of the investigation area are presented in OGERMANN *et al.* (1994). Until 1993, the site was grazed by cattle from May to September with a high stocking rate. The lower part of the slope was moderately fertilized by cattle dung.

The investigation area in Movelier (1.3 ha) is situated on a SSE-facing slope (inclination 20-22°) at an altitude of 780 m. Half of the site is surrounded by deciduous forest. The humus layer is relatively thick, contains some clay and is moister than in Nenzlingen and Vicques. Until 1993, the site was grazed by cattle and a moderate amount of artificial fertilizer was used.

The investigation area in Vicques (2.0 ha) is situated on a SE-facing slope (inclination 15-27°) at an altitude of 570 m. The humus layer is thin and there are several patches of exposed bedrock (this type of habitat is lacking at the other sites). There is mixed forest at the SW-border of the area. Until 1993, the site was exposed to a low grazing pressure by cattle.

In spring 1993, we initiated a field experiment to investigate possible effects of habitat fragmentation on animal and plant populations at these sites. We experimentally fragmented selected areas of grassland into plots of different sizes to examine whether species diversities of plants and various groups of invertebrates change after fragmentation. The fragmentation was created by mowing the vegetation around the experimental plots (see BAUR & ERHARDT (1995) for a figure of the experimental set-up). An experimental unit (= block) contains one large (4.5 x 4.5 m), one medium (1.5 x 1.5 m) and two small fragments (0.5 x 0.5 m), all of them separated by a 5-m wide strip of mown vegetation, as well as the corresponding control plots. The experiment consists of 12 blocks distributed over the three sites (five blocks in Nenzlingen, three blocks in Movelier and four blocks in Vicques). The fragmentation is maintained by regularly mowing the isolation area. This type of fragmentation is

reversible, but reduces dispersal of pollen and seeds in many plant species as well as dispersal of several invertebrate species.

In this paper, we present data on species richness and abundance of vascular plants and various groups of invertebrates at the beginning of the long-term experiment. We have tried to minimize any additional disturbances of the fragmented ecosystem by using non-destructive methods whenever possible. Data were collected either within the experimental blocks (plants, grasshoppers and terrestrial gastropods), at the border of each experimental block (oribatid mites), and/or in the areas adjacent to or surrounding the experimental blocks (spiders, diplopods, grasshoppers, ground beetles, butterflies and terrestrial gastropods). Species determination of grasshoppers, butterflies and gastropods occurred *in situ*. Pitfall trapping was used for other taxonomical groups in which species identification is difficult in the field (spiders, diplopods, ground beetles). Details on the collecting methods are given in the corresponding sections dealing with the different groups of organisms.

DATA ANALYSIS

Diversity has two components, the species richness measured by the total number of species in an area, and the equitability of species abundances. The number of species was used as a measure of the relative richness of the grasslands, but it cannot be thought of as the absolute richness of a site, since numerous rare species may not have been recorded in this study. The diversities of different taxonomic groups were compared using the Shannon-Wiener index (H' , base e) and the equitability or evenness (E) of distribution of individuals among the species (LLOYD & GHELARDI 1964, KREBS 1988).

Species-abundance distributions were plotted to compare the proportion of rare species (species with one individual) among the different taxonomical groups. The similarity of the different species assemblages were compared using the coefficient of Sørensen (based on presence/absence data) and the Renkonen index (based on abundance data; KREBS 1988, MÜHLENBERG 1989).

VASCULAR PLANTS

Jasmin JOSHI and Bernhard SCHMID

METHODS

Plant species richness was recorded in all fragments and control plots during the growing seasons of 1993 and 1994. Data on the presence/absence of plant species were obtained in Nenzlingen in May, June and August 1993 and in May and August 1994, in Movelier in June and August 1993 and at the beginning of June and in August 1994, and in Vicques at the beginning of July and in August 1993 and in May and August 1994. In August 1994, the recording in Nenzlingen took place after mowing of the experimental plots. Therefore, the presence of some grass species may have been overlooked.

Nomenclature of the vascular plants follows BINZ & HEITZ (1990). Endangered and threatened species are listed in LANDOLT (1991).

RESULTS AND DISCUSSION

A total of 143 plant species were found in the three investigated calcareous grasslands (Appendix 1). The highest plant species richness was found in Movelier (116 species), where only 24 plots were investigated. In Nenzlingen we recorded 111 plant species (in 40 plots) and in Vicques 96 species (in 32 plots). Seventy-seven of the 143 species (53.8%) were recorded at all three sites (Table 1). Movelier also had the highest proportion of plant species of the total species pool found exclusively at one site (15.4%) compared with Nenzlingen (7.7%) and Vicques (4.9%) (Table 2).

TABLE 1

Species richness and species overlap of diverse taxonomical groups at the three investigation sites Nenzlingen, Movelier and Vicques.

Taxonomical group	Number of species recorded in			Total number of species recorded (species pool)	Number (%) of species that occurred at all sites
	Nenzlingen	Movelier	Vicques		
Vascular plants	111	116	96	143	77 (53.8)
Spiders	60	63	66	108	27 (25.0)
Oribatid mites	18	18	18	31	10 (32.3)
Millipedes	1	4	7	8	1 (12.5)
Grasshoppers	13	16	10	17	8 (47.1)
Ground beetles	19	19	21	38	7 (18.4)
Butterflies	32	46	40	46	26 (56.5)
Terrestrial gastropods	21	16	15	22	13 (59.1)

TABLE 2

Number of species and percentage of the total species pool (in parentheses) that occurred exclusively at one site.

Taxonomical group	Nenzlingen	Movelier	Vicques
Plants	11 (7.7)	22 (15.4)	7 (4.9)
Spiders	14 (13.0)	19 (17.6)	21 (19.4)
Oribatid mites	4 (12.9)	7 (22.6)	5 (16.1)
Millipedes	0	1 (12.5)	4 (50.0)
Grasshoppers	0	3 (17.6)	0
Ground beetles	10 (26.3)	6 (15.8)	9 (23.7)
Butterflies	0	7 (15.2)	0
Terrestrial gastropods	4 (18.2)	1 (4.5)	0

All three sites were dominated by *Bromus erectus*, a typical grass species of extensively managed calcareous grasslands. *Sanguisorba minor*, *Ranunculus bulbosus* and *Hieracium pilosella* also occurred frequently at each site. Two of the species

which were found at all three sites (*Trifolium ochroleucon* and *Veronica prostrata*) are listed as vulnerable in the Red Data Book of Switzerland (Landolt 1991). Furthermore, *Gentiana cruciata*, found exclusively in Vicques, is also considered as vulnerable in Switzerland. Altogether, seven of the 143 species (4.9%) recorded belong to the endangered species, 19 (13.3%) to the vulnerable species and one (0.7%) to the rare plant species in the northern Jura mountains (Landolt 1991).

SPIDERS (Arachnida, Araneae)

Ambros HÄNGGI

METHODS

Pitfall traps were used to collect ground-living arthropods (Araneae, Diplopoda and Coleoptera). The traps were white plastic jars, 7 cm deep x 7 cm in diameter, containing about 50 ml formalin (4%) with detergent. The traps were protected against rain by grey plastic roofs (measuring 18 x 18 cm) that were fixed horizontally about 10 cm above ground. Specimens were removed and formalin replaced at intervals of two weeks from 5 May to 12 November 1994. At each site, nine traps were placed in groups of three (within-group distance 1 m) in three different grassland subtypes.

At each site, the grassland subtypes considered were 50 - 100 m apart; they may reflect the heterogeneity of the three grasslands. In Nenzlingen the grassland subtypes were (1) a moderately fertilized patch of the pasture, (2) an unfertilized area (typical Mesobrometum), and (3) a patch dominated by bracken (*Pteridium aquilinum*); in Movelier (1) a moderately fertilized patch of the pasture, (2) an unfertilized area (typical Mesobrometum), and (3) a part of the slope structured by cow paths; in Vicques (1) an unfertilized area of the pasture with exposed bedrock (karst rocks), (2) an unfertilized area (typical Mesobrometum), and (3) a patch of the pasture (5 x 10 m) partly covered with bramble (*Rubus* spp.).

Spiders were determined by Theo Blick, Hummeltal (Germany). Nomenclature follows MAURER & HÄNGGI (1990). All spiders collected are deposited in the Naturhistorisches Museum Basel.

RESULTS AND DISCUSSION

A total of 2701 adult spiders belonging to 108 species were collected at the three study sites (Appendix 2). The sites were similar in species richness (60 species in Nenzlingen, 63 in Movelier and 66 in Vicques), but differed in species composition (Table 1, Appendix 2). Only 27 of the 108 species (25.0%) were found at all three sites (Table 1). Twenty-one (19.4%) of the total 108 species were exclusively found in Vicques, indicating an extraordinary spider community in this grassland (Table 2). The highest similarity was found between the spider communities in Nenzlingen and Movelier, whereas the spider community in Vicques was quite different from those of the other sites (Table 3). Diversity expressed by the Shannon-Wiener index (H') was

TABLE 3

Comparison of similarity in different groups of organisms at the three field sites. Ne = Nenzlingen, Mo = Movelier, and Vi = Vicques.

		Sørensen similarity index			Renkonen similarity index		
		Ne-Mo	Ne-Vi	Mo-Vi	Ne-Mo	Ne-Vi	Mo-Vi
Vascular plants	1993	0.79	0.82	0.74	—	—	—
	1994	0.79	0.82	0.76	—	—	—
Spiders		0.59	0.59	0.54	0.57	0.35	0.41
Oribatid mites		0.56	0.67	0.50	0.61	0.40	0.64
Millipedes		0.40	0.25	0.55	0.91	0.73	0.76
Grasshoppers	1993	0.82	0.78	0.80	0.61	0.63	0.73
	1994	0.91	0.74	0.76	0.60	0.53	0.60
Ground beetles		0.47	0.40	0.55	0.31	0.21	0.24
Butterflies	1993	0.78	0.90	0.88	—	—	—
	1994	0.79	0.87	0.92	—	—	—
Gastropods		0.81	0.83	0.84	0.84	0.83	0.80

highest in Vicques, whereas Movelier and Nenzlingen showed slightly lower H' -values (Table 4).

Relating the number of individuals caught (Appendix 2) to the number of trapping days (1719 trapping days per site), the activity density of spiders was lower at the three sites (Table 5) than has been reported from similar habitats (Inntal: THALER 1985; Tessin: HÄNGGI 1992). The reason for this discrepancy might be that the collection period lasted only six months in the present study (animals were caught during the period of vegetation growth).

Several spider species collected are interesting from a faunistic point of view. *Oxyptila pullata* was found for the first time in Switzerland (two males were collected in Vicques; one between 5 and 18 May 1994, the other between 14 September and 1 October 1994). This species is known to occur in extremely dry grasslands and

TABLE 4

Shannon-Wiener diversity index (H') and evenness (E ; in parentheses) in various invertebrate groups at the three investigation sites. Where the sampling effort was unequal (oribatid mites, grasshoppers and gastropods), the values have been calculated for equal subsamples of three blocks (see Methods).

Taxonomical group	Nenzlingen	Movelier	Vicques
Spiders	2.96 (0.72)	3.02 (0.73)	3.18 (0.76)
Oribatid mites	2.06 (0.72)	1.58 (0.55)	1.81 (0.64)
Grasshoppers (1993)	1.72 (0.81)	1.80 (0.75)	1.73 (0.86)
	1.41 (0.70)	1.77 (0.78)	1.76 (0.85)
Ground beetles	2.50 (0.85)	2.43 (0.83)	2.55 (0.84)
Terrestrial gastropods	1.25 (0.51)	1.26 (0.62)	1.46 (0.70)

TABLE 5

Relative densities of various invertebrate groups at the three investigation sites.

Taxonomical group	Nenzlingen	Movelier	Vicques
Spiders (individuals/trapping day)	0.61	0.49	0.48
Oribatid mites (individuals/m ²)	18'700	19'200	5'600
Grasshoppers (1993)	43.8	66.2	45.2
(individuals/block) (1994)	47.9	59.1	42.8
Ground beetles (individuals/trapping day)	0.09	0.04	0.08
Terrestrial gastropods (individuals/trap)	0.83	0.18	0.13

habitats with rocks, stones or sand in southern and eastern Europe (BAUCHHENS 1990). *Talavera* (= *Euophrys*) *inopinata* was collected for the second time in Switzerland (two males in Vicques between 15 and 29 June 1994 and one female in Movelier between 17 and 24 July 1994). This species was described by Wunderlich (1993) based on specimens collected in similar habitats in the region of the present study (Jura mountains between Delémont and Porrentruy; see HÄNGGI 1993).

A further taxon, *Pardosa* sp. (not listed in MAURER & HÄNGGI 1990), has not yet been described, but may belong to the species group of *Pardosa lugubris* s.l. (TÖPFER-HOFMANN & VON HELVERSEN (1990) named this taxon *Pardosa saltans* (nomen nudum!)). Most probably this undescribed taxon occurs more frequently in Switzerland than *P. lugubris* s.str., as indicated by museum specimens (most of them wrongly determined as *P. lugubris*). *Pardosa* sp. was found in small numbers at all three sites.

Six further species can be regarded as rare (recorded fewer than five times in Switzerland; cf. MAURER & HÄNGGI 1990): *Bathypantes parvulus*, *Centromerita concinna*, *Tegenaria picta*, *Eperigone trilobata*, *Mioxena blanda* and *Dipoena prona*. A single specimen of each of the first three species was collected in this study. Information on the ecology of these species is summarized in HÄNGGI *et al.* (1995). *Eperigone trilobata* is widespread in northern America and was most probably introduced to Europe some 20 years ago (DUMPERT & PLATEN 1985). *Eperigone trilobata* can now frequently be found in dry, unfertilized grasslands in central Europe (HÄNGGI 1990, RENNER 1992). *Dipoena prona* (three males collected in Vicques between 24 July and 5 August 1994) is a widespread species, but is rarely found in Europe (MILLER 1967). *Mioxena blanda* (one male caught in Nenzlingen between 13 and 27 October 1994) is widely distributed but rare in northern and western Europe (ROBERTS 1985).

No Red Data List has been compiled for spiders in Switzerland. However, 27 of the 108 (25.0%) species found in the present study have narrow niches (ste-noecious; MAURER & HÄNGGI 1990). Most of these spiders seem to be thermophilous,

preferring dry, open habitats. These types of habitat have dramatically declined in Switzerland. Consequently, these 27 species can be regarded as potentially endangered mainly due to habitat destruction. Vicques harbours a particularly threatened spider fauna since 11 of the 21 species recorded exclusively at this site belong to the group of potentially endangered species.

ORIBATID MITES (Acari, Oribatei)

Daniel BORCARD & Josef STARY

METHODS

Cylindrical soil samples, 5 cm in diameter and 8 cm in depth, were taken at the margins of the control areas of each experimental block, using the soil augers described by BIERI *et al.* (1978). The samples were divided into two parts (0-4 cm and 4-8 cm). The soil fauna was extracted by means of a MacFadyen-derived extractor (BORCARD 1986). Each site was sampled three times, on 10 March, 19 July and 14 November 1994. Four samples were taken in each block on each occasion. In all, 144 samples were taken.

RESULTS AND DISCUSSION

A total of 4079 adult oribatid mites belonging to 31 different species were captured at the three sites (Appendix 3). At each site, 18 mite species were found. However, species number is often influenced by sampling effort. To account for the lower number of blocks sampled in Movelier ($n = 3$), we computed the expected number of species at the two other sites, assuming that only three blocks had been sampled. The average of the total number of species of each possible combination of three blocks was 17.5 in Nenzlingen and 17.0 in Vicques.

Eight of the 31 mite species (25.8%) were found at all three sites (Table 1, Appendix 3). In contrast, four species (12.9%) were exclusively found in Nenzlingen, seven species (22.6%) exclusively in Movelier and five species (16.1%) exclusively in Vicques (Table 2).

The differences in species composition between seasons were small, accounting for 2.7% of the total variation as indicated by a canonical correspondence analysis (CCA; TER BRAAK 1986). Consequently, data from the three sampling occasions were pooled for each site for further analysis. Moreover, unless noted otherwise, all mites collected (depth 0-8 cm) were considered, although the majority of the mites were found in the upper soil layer (between 0 and 4 cm depth; Nenzlingen 84.2%, Movelier 71.8% and Vicques 65.6%).

The among-site differences in species composition were significant as indicated by a CCA including all 144 samples (Monte Carlo test, 999 permutations, $p = 0.001$). These differences accounted for 11.4% of the total variation. In this analysis, Vicques represented the most heterogeneous sampling site. Overall the species richness was low when compared with other biotopes (such as forests), but normal for

open grassland (BACHELIER 1978). In comparison with the two other sites, Vicques again represented an extraordinary site: the local richness (as measured by the average number of species per sample) was very low (about half that of Nenzlingen), but this was compensated by the overall heterogeneity of the site.

With estimated values of slightly below 20'000 individuals/m², the overall densities of the mite communities in Nenzlingen (18'700 individuals/m²) and Movelier (19'200 individuals/m²) corresponded well to those described in the literature for similar habitats (for a review see Bachelier 1978). In contrast, Vicques had an extremely low mite density (5'600 individuals/m²). This can be partly explained by the dryness as well as by the scarce vegetation and extremely shallow soil at this site.

Two species, *Epilohmannia cylindrica minima* (in Movelier) and *Pergalumna myrmophila* (in Vicques), were recorded for the first time in Switzerland. So far, these species have been considered as specialists that occur in the Mediterranean subregion and Pannonian district. With the exception of *Minunthozetes semirufus*, all species captured at only one of the three sites had low densities. The most important components of the investigated oribatid mite communities include semicosmopolitan species (nine species, i.e. 29% of the total species number) and holarctic species (10 species; 32%). Most of these species are eurytopic with a large ecological amplitude (e.g. *Oppiella nova*, *Scheloribates laevigatus*, *Xylobates capucinus* and *Tectocephus sarekensis*), and are usually dominant in early stages of secondary succession or indicate non-stabilized biotopes affected by human activity. Ten species (32%) are found only in Europe.

MILLIPEDES (Diplopoda, Myriapoda)

Ariane PEDROLI-CHRISTEN

METHODS

Pitfall traps were used to collect millipedes as described in the spider section (see above). Nomenclature follows PEDROLI-CHRISTEN (1993).

RESULTS AND DISCUSSION

A total of 154 adult diplopods belonging to eight species were collected (Appendix 4). Seven species were found in Vicques, four in Movelier and one in Nenzlingen. *Cylindroiulus caeruleocinctus* dominated the diplopod communities at all three sites (100% in Nenzlingen, 91% in Movelier and 73% in Vicques). This species is characteristic for open and exposed habitats such as calcareous grasslands. It can occasionally occur along forest edges, but never in the forest. The remaining species (*Glomeris* spp. and *Tachypodoiulus niger*) are associated with woody habitats, but can also occur in stands of bramble (in Vicques). None of the diplopod species recorded in the present study is rare.

GRASSHOPPERS, BUSH CRICKETS AND TRUE CRICKETS

(Orthoptera: Saltatoria)

G. Heinrich THOMMEN

METHODS

The relative abundances of the different Saltatorian species were recorded in the experimental blocks (isolated fragments and the corresponding control plots) using a direct census method. The entire vegetation of the experimental plots was carefully searched for Saltatoria. Plants were slightly moved with a bamboo rod for an easier detection of the insects. In addition, in each block an area of 4.5 x 4.5 m of mown vegetation (isolation area of the experiment) was searched for Saltatoria. The number of individuals observed was recorded for each species (no animals were caught). Monitoring was repeated three times at all sites between July and early September both in 1993 and 1994.

A transect count technique was used to record the composition and relative abundance of Saltatorian species in the grassland surrounding the experimental blocks. These areas (1-2 ha in size) were slowly walked through in a zigzag line. All adult individuals seen within a strip of 1-1.2 m width were counted. The adjacent areas were surveyed once at each of the three sites during summer 1994.

Only Saltatoria species that typically inhabit unwooded open land were censused. True arboreal species and inhabitants of the forest edge were not included in this study. Nomenclature follows BELLMANN (1993).

RESULTS AND DISCUSSION

Thirteen species of Saltatoria were recorded in Nenzlingen (11 of them in the experimental blocks), 16 species in Movelier (14 in the experimental blocks), and 10 species in Vicques (9 in the experimental blocks; Appendix 5). A total of 17 species were recorded from all three sites combined, which represents approximately half of the Saltatorian species known in dry grasslands of the Swiss Jura mountains. Eight of the 17 (47.1%) species occurred at all three sites (Table 1).

The higher species richness in the areas adjacent to the experimental blocks could be explained by the larger size and higher degree of heterogeneity of these areas. The surrounding areas are more variable in cover and height of vegetation, in soil moisture content, inclination of slope and in the structure of the surface (e.g. single rocks or exposed limestone bedrock) than the experimental blocks. Patches with relatively high soil moisture may explain the presence of *Metrioptera roeselii* in Nenzlingen as well as *Metrioptera brachyptera* and *Chrysocraon dispar* in Movelier; all three species are mesohygrophilic, preferring moist or tall grass habitats. These three species are lacking in Vicques, the driest of the three sites.

Chorthippus parallelus, usually associated with fertilized meadows, was one of the most frequent species (19-32% of all adult individuals) at all three investigation sites. *Stenobothrus lineatus*, a mesoxerophilic grasshopper species, was frequent (23-31%) in the experimental blocks at all three sites, but less frequent (10-17%) in the

surrounding areas. *Chorthippus biguttulus*, another mesoxerophilic species, was frequent in Nenzlingen (24%) and in Vicques (21%), whereas *Gomphocerus rufus*, which prefers the higher herbaceous stratum (e.g. *Rubus* spp.) in close vicinity to scrub and woodland, was common in Movelier (22%).

Only juvenile stages of *Gryllus campestris* were observed in the period from July to early September. In the present survey, the low representation of this ground-dwelling cricket may be due to the difficulty of observing it under a dense vegetation layer. Similarly, the abundance of *Tetrix tenuicornis* might have been underestimated due to its inconspicuous colour and small size.

Eight of the 17 species (47.1%) recorded in this study are listed in the Red Data Book of Northern Switzerland (Appendix 5; NADIG & THORENS 1994). Movelier harboured the largest number of Red Data Book species (8 species), followed by Vicques (6 species) and Nenzlingen (5 species; Table 6).

TABLE 6

Number and percentage (in parentheses) of species that are listed in the Red Data Book of Switzerland (cf. LANDOLT 1991, DUELLI *et al.* 1994).

Taxonomical group	Nenzlingen	Movelier	Vicques
Plants	11 (9.9)	23 (19.8)	14 (14.9)
Grasshoppers	5 (38.5)	8 (50.0)	6 (60.0)
Ground beetles	1 (5.3)	1 (5.3)	2 (9.5)
Butterflies	7 (21.9)	16 (34.8)	12 (30.0)
Terrestrial gastropods	3 (14.3)	2 (12.5)	1 (6.7)

GROUND BEETLES (Coleoptera, Carabidae)

Ambros HÄNGGI & Henryk LUKA

METHODS

Pitfall traps were used to collect ground beetles as described for spiders (see above). Ground beetles were determined by Henryk Luka. Nomenclature follows FREUDE *et al.* (1976) and LOHSE & LUCHT (1989). A reference collection is deposited at the Naturhistorisches Museum Basel.

RESULTS AND DISCUSSION

A total of 366 ground beetles belonging to 38 species were collected (Appendix 6). Compared with studies on intensively managed grasslands (e.g. TIETZE 1985), the number of individuals caught was low, whereas the number of species was high. This confirms the findings of STRÜVE-KUSENBERG (1980), TIETZE (1985) and ZELTNER (1989) that in ground beetle communities the ratio of species number to the number of individuals is high in extensively used grasslands and low in intensively used grasslands.

The three sites had similar numbers of species (19 species in Nenzlingen, 19 in Movelier and 21 in Vicques). However, the three sites differed considerably in species composition. Seven of the 38 carabid species (18.4%) were found at all three sites (Table 1). On the other hand, a high proportion of species occurred exclusively at one site: 47.4% in Nenzlingen, 31.6% in Movelier, and 42.9% in Vicques (Table 2). This resulted in a low similarity of the species assemblages between the sites (Table 3). Diversity expressed by the Shannon-Wiener index H' was highest in Vicques, followed by Nenzlingen and Movelier (Table 4).

Four of the 38 (10.5%) carabid species found are listed in the Red Data Book of Switzerland (MARGGI 1994). *Anisodactylus nemorivagus* was exclusively found in Nenzlingen. Little is known concerning the life history of this species (LINDROTH 1945, MARGGI 1992). We collected individuals of *A. nemorivagus* in the moderately fertilized patch and the typical Mesobrometum part of the grassland in Nenzlingen. Only one individual of *Carabus convexus* was found in the typical Mesobrometum part of Movelier. This species does not tolerate intensively cultivated grasslands and is considered as threatened (MARGGI 1992). In general, *C. convexus* is not rare in the Swiss Jura mountains (MARGGI 1992). Two further species listed in the Red Data Book were found exclusively in Vicques. All 10 individuals of *Carabus auratus* were caught in the patch partly covered with bramble. *Carabus auratus* is also restricted to extensively cultivated open areas. The four individuals of *Panagaeus bipustulatus* were caught in the patch partly covered with bramble and in the area with exposed bedrock in Vicques. This species seems to be strongly xerophilous (MARGGI 1992).

A high number of polyphagous-phytophagous species (belonging to the genera *Amara*, *Anisodactylus*, *Harpalus* and *Parophonus*), which also climb onto the vegetation, was collected in Nenzlingen (cf. WACHMANN *et al.* 1995). In Movelier, there was a surprisingly high proportion of large species of *Carabus* (32% of all species, 37% of all individuals). Among them was *Carabus monilis*, which does not tolerate intensive management of grasslands (MARGGI 1992, PFIFFNER & LUKA 1994). Indeed, we collected no specimens of this species in the fertilized patch of the grassland. The carabid community of Vicques was characterized by thermophilous species such as *Panagaeus bipustulatus* and *Callistus lunatus*. The latter is known to prefer temperatures reaching 40-50 °C (BECKER 1975, THIELE 1977).

BUTTERFLIES (Lepidoptera)

Hans-Peter RUSTERHOLZ & Andreas ERHARDT

METHODS

Estimates of species richness were obtained from observations on the activity of foraging butterflies. Three 10 x 10 m plots were established in undisturbed grassland vegetation adjacent to the blocks of the fragmentation experiment at each site. Butterfly activity was recorded for periods of 45 min. between 10.00 a.m. and 4.30 p.m. during sunny weather conditions. The number of individuals of each species was

counted in the plots. Observations were made on eight days between the end of May and the end of August in 1993, and on 9 days between the beginning of June and the end of August in 1994. Each plot was observed for a total of 6.5 hours in 1993 and 7.25 hours in 1994. True arboreal butterfly species were excluded from this study. Nomenclature follows the "LEPIDOPTEROLOGEN-ARBEITSGRUPPE" (1987) and KOCH (1991).

RESULTS AND DISCUSSION

A total of 46 butterfly species were recorded at the three study sites which represent 65% of the butterfly species occurring in the Swiss Jura mountains (Appendix 7; GONSETH 1987, "LEPIDOPTEROLOGEN-ARBEITSGRUPPE" 1987, GONSETH & GEIGER 1984, 1985). Twenty-eight and 30 butterfly species were observed in Nenzlingen in 1993 and 1994, respectively. The corresponding figures for Movelier were 45 and 46 species and those for Vicques 35 and 39 species.

A comparison of the three sites shows that 30 species (65.2%) occurred at all sites (Table 1), whereas seven species were exclusively found in Movelier (Table 2). All species observed in Nenzlingen were also found at the other sites. Nine of the 46 butterfly species (19.6%) are endangered or vulnerable (Appendix 7) and are therefore of special interest for conservation issues (GONSETH 1994).

Species richness was lowest in Nenzlingen and highest in Movelier. The pronounced differences in species richness at the three sites could be due to differences in spatial heterogeneity, in plant composition and vegetation structure, and/or intensity of grassland management (ERHARDT 1985). The latter suggestion is supported when only butterfly species closely associated with typical calcareous grassland are considered (Appendix 7). The high intensity of grassland management in Nenzlingen might be responsible for the reduction of approximately 50% of the *Lycaenidae* species compared to the other sites, and for the similar reduction in the number of threatened species (Appendix 7). These butterfly species are particularly sensitive to alterations of habitat quality such as a reduced variability of habitat structure and intensification of grassland management (ERHARDT 1985). It follows that these butterfly species can be considered as excellent indicators of habitat type and quality.

TERRESTRIAL GASTROPODS (Mollusca, Gastropoda)

Peter OGGIER, Stephan LEDERGERBER & Bruno BAUR

METHODS

BOAG (1982) demonstrated that wet sheets of cardboard or masonite placed in grassland vegetation create a moister microclimate, and thus attract gastropods onto the underside of the sheets. We used this type of non-destructive traps to record the relative abundance of gastropod species in the experimental blocks. Using a 1 m²-grid, we placed one sheet of cardboard (10 x 10 cm) per m² over the entire area of

each block (32 x 32 m; see BAUR & ERHARDT 1995). In the isolated fragments and the corresponding control plots we increased the trap density to four sheets of cardboard per m². Thus, the sampling effort was 1208 cardboard traps per block.

The efficiency of this trapping method is largely influenced by weather conditions. We placed the cardboards into the vegetation in the evening (between 6 and 8 p.m.) of a rainy day and inspected them for adhering gastropods on the following morning (between 7 and 10 a.m.). We identified the gastropods in the field, recorded the number of individuals per species and released the animals at the same spot where they were trapped. In this way, each of the 12 blocks was examined once for gastropods between 14 September and 26 October 1994.

True forest species and inhabitants of forest edge that may occasionally enter grassland (e.g., *Cochlodina laminata* and *Perforatella incarnata* in Nenzlingen, *Helicodonta obvolvata*, *Aegopinella pura* and *Nesovitrea hammonis* in Movelier, and *Cochlostoma septemspirale* in Vicques) were not included in this study. Juvenile slugs of the family Limacidae were counted but could not be determined to the species level in the field. In the species lists we also included records of gastropods that were observed in the course of other studies (e.g. species associated with rocks that were not caught by the traps used). Nomenclature follows KERNEY *et al.* (1983).

RESULTS AND DISCUSSION

Considering all three sites, a total of 22 gastropod species were recorded (Table 1). The three grasslands differed in gastropod species richness: 21 species were found in Nenzlingen, 16 in Movelier and 15 in Vicques (Appendix 8). Thirteen of the 22 (59.1%) gastropod species were recorded at all three sites (Table 1).

The investigation area in Nenzlingen had the highest species richness. This finding can be partly explained by the larger sampling effort made at this site (five blocks compared with three blocks in Movelier and four blocks in Vicques). Considering only gastropods recorded with the trapping method, we calculated the expected number of species assuming that only three blocks were sampled at each site. The average of the total species number of each possible combination of three blocks was 13.4 (15 in five blocks) in Nenzlingen, and 10.5 (11 in four blocks) in Vicques compared with 12 species in Movelier. Thus, the species richness was highest in Nenzlingen even when differences in sampling effort were accounted for. The larger heterogeneity of the investigation area in Nenzlingen (see description of study sites) might contribute to the relatively high species richness observed.

The slug *Deroceras reticulatum* was the most frequent species at all three sites, followed in decreasing abundance by *Trichia plebeia*, *Helicella itala*, *Pupilla muscorum*, *Vertigo pygmaea* and *Cochlicopa lubrica*. The three sites differed significantly in gastropod density. A sheet of cardboard attracted on average 0.83 individuals in Nenzlingen, 0.18 individuals in Movelier and 0.13 individuals in Vicques (Table 5). Different factors may influence snail abundance in grasslands. Differences in plant cover, structure, moisture and depth of soil and in the amount of precipitation

might be the most prominent ones. However, further experimental studies are needed to increase our understanding of causes that affect local land snail density.

Three species (*Helicella itala* at all sites, *Helix pomatia* in Nenzlingen and Movelier and *Vitrea contracta* in Nenzlingen) are listed in the Red Data Book as potentially endangered in Northern Switzerland (TURNER *et al.* 1994).

One of the advantages of the sampling technique used is the possibility to compare different areas at a given time without removing the animals and destroying the vegetation. However, this trapping technique may attract different species to a different extent. Based on the experience of mark-release-recapture experiments, we assume that *Vertigo pygmaea* is underrepresented in the present data set. However, the extent to which the cardboard technique accurately reflects the abundances of the species present at each site is difficult to test because other sampling techniques may be subject to other biases (BOAG 1982).

GENERAL RESULTS AND DISCUSSION

COMPARISON OF SPECIES RICHNESS BETWEEN SITES

Table 1 gives an overview of the number of species recorded in the various taxonomical groups for each site. Combining data from the eight taxonomical groups, Movelier showed the highest species richness (298 species), followed by Nenzlingen (275 species) and Vicques (273 species). Vicques, which harboured the smallest number of plant species, had a relatively large number of invertebrate species, but a relatively low number of herbivores.

In general, there were no clear associations between plant species richness and species richness of any invertebrate group. One may expect a close association between the species richness of plants and butterflies (ERHARDT 1985). However, this association might exist beyond the spatial scale of the present study (investigation areas of 1–2 ha) in these highly mobile animals. The fact that different taxonomical groups showed low associations in species richness is important for conservation issues. So far, plant species richness has preferentially been used to assess the conservation value of an unfertilized grassland or any other potential nature reserve in Switzerland. However, a site with a relatively low plant species richness (e.g. Vicques) may contain a variety of highly endangered invertebrates. A proper judgement of the conservation value of a potential area should therefore consider species diversity of more than one group of organisms (for other criteria see below).

Diversity expressed by the Shannon-Wiener index (H') was compared among five groups of invertebrates. Diversity was highest in spiders and ground beetles (Table 4) and lowest in terrestrial gastropods. The latter may be due to the dominance of a single gastropod species (*D. reticulatum*). There was a considerable between-site variation in diversity among the different taxonomical groups (Table 4). Each site had the highest diversity in at least one taxonomical group. However, it is dangerous to base a conservation evaluation on diversity indices alone. Sites with a high con-

ervation value often have a low diversity (SOULÉ 1986). Other criteria, such as the rarity of the habitat type or the number of endangered and threatened species that the habitat contains might be more helpful for conservation evaluation. For example, the highest number of unique species (species that were exclusively found at one site) was recorded in Movelier (60 species). Vicques harboured 46 unique species and Nenzlingen 43 (Table 2). Furthermore, the number of species listed in the Red Data Book was highest in Movelier (49 species; Vicques: 34 species; Nenzlingen: 27 species; Table 6). For a proper judgement of the conservation value of a grassland, we suggest to survey at least three different taxonomical groups whose species have low associations with each other and occur at different levels of the trophic chain.

Species overlap (number of species that occurred at all sites) varied among taxonomical groups (Table 1). Species overlap was relatively large in terrestrial gastropods (59.1%), butterflies (56.5%), vascular plants (53.8%) and grasshoppers (47.1%), but relatively low in oribatid mites (32.3%), spiders (25.0%), ground beetles (18.4%) and diplopods (12.5%). Species overlap was much higher in herbivores (gastropods, butterflies and grasshoppers; mean: 54.9%) than in ground- and soil-dwelling invertebrates (spiders, oribatid mites and ground beetles; mean 25.2%). The species overlap of herbivores was very close to that of vascular plants (53.5%), which could reflect an association of herbivores with food plants. Soil predators, on the other hand, are not directly associated with plant species, but are restricted in their occurrence by soil conditions (THIELE 1977). Small-scaled variations in soil properties between the sites are most likely to be responsible for the recorded differences in the species composition of soil-dwelling arthropods.

A high proportion of spiders, oribatid mites and ground beetles were found exclusively at one site (Table 2). Most of the species are rare, as indicated by the shape of the species abundance distributions (Fig. 1). In the grasslands examined, a few species were dominant in their communities (e.g., the grass *Bromus erectus* among the plants, *Xylobates capucinus* among the oribatid mites, *Cylindroiulus caeruleocinctus* among the diplopods and the slug *Deroceras reticulatum* among the gastropods).

At the species level, there was a positive correlation between the total number of individuals recorded (or caught) and the number of sites occupied (Spearman rank correlation; spiders: $r_s = 0.67$, $n = 106$, $p < 0.001$; oribatid mites: $r_s = 0.78$, $n = 31$, $p < 0.001$; grasshoppers: $r_s = 0.74$, $n = 13$, $p < 0.01$; ground beetles: $r_s = 0.58$, $n = 39$, $p < 0.001$; terrestrial gastropods: $r_s = 0.89$, $n = 17$, $p < 0.001$). As an example, the correlation between the number of collected oribatid mites and the number of investigation sites occupied by the 31 different mite species is presented in Fig. 2. Thus, in all invertebrate groups, species that were numerically dominant occurred on average at more than one site. Similar findings have been reported for ground beetles at different sites in Finnish mature taiga (NIEMELÄ *et al.* 1994).

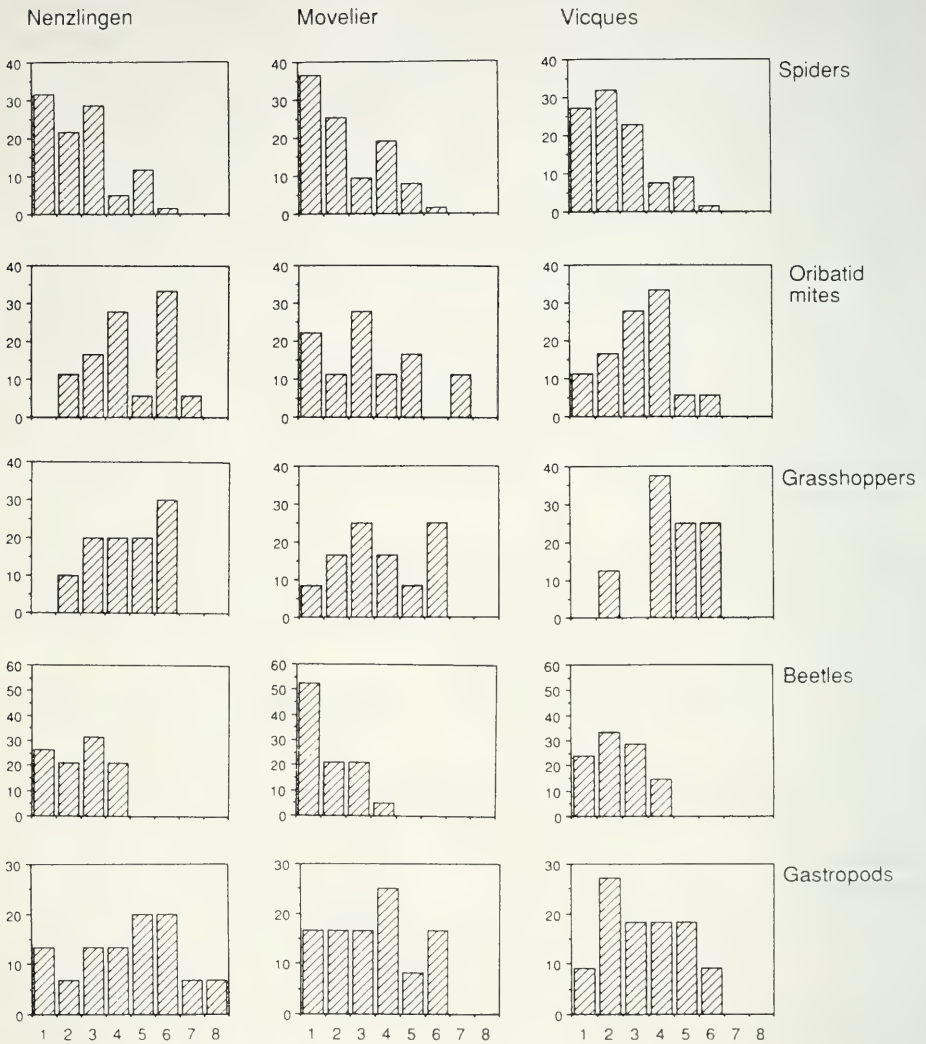


FIG. 1

Percentage of species in various invertebrate groups at the three sites plotted against number of individuals arranged in abundance classes with log3 base. The y-axis indicates the relative abundance (%) of species and the x-axis refers to individuals in abundance classes.

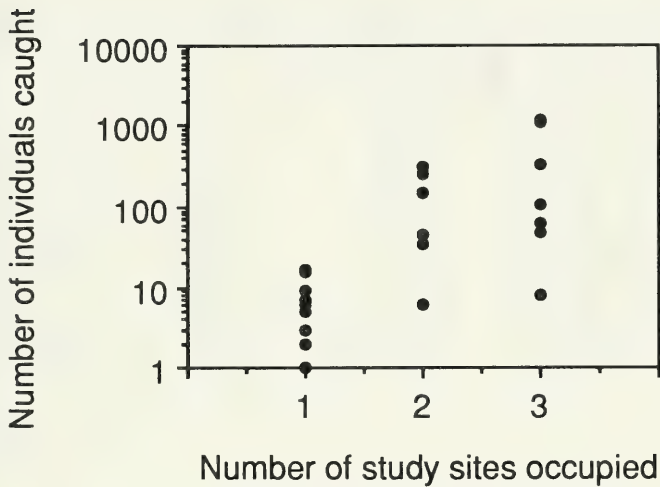


FIG. 2

Correlation between the number of individuals collected per species and the number of study sites occupied by the 31 oribatid mite species (Spearman rank correlation: $r_s = 0.78$, $n = 31$, $p < 0.001$).

SIMILARITY OF SPECIES ASSEMBLAGES

Sørensen's similarity coefficient of species composition and Renkonen's similarity index varied between groups of organisms (Table 3). In general, herbivores (grasshoppers, butterflies and gastropods) had more similar species assemblages between the investigated sites than ground-dwelling arthropods (spiders, oribatid mites and ground beetles). Considering all taxonomical groups, there was no distinct similarity pattern of species composition between the sites examined. Each site combination had the highest similarity of species composition in at least one group of organisms.

BETWEEN-SITE DIFFERENCES IN LOCAL POPULATION DENSITY

The three sites also varied in the abundance of different groups of organisms (Table 5). For example, with the same sampling effort, on average six times more gastropods were caught in Nenzlingen than in Vicques. Similarly, high densities of oribatid mites were found in Nenzlingen and Movelier, but a low density in Vicques. Figure 3 shows the relative densities of various invertebrate groups. Most invertebrate groups had the highest densities in Nenzlingen, suggesting that this site might be the most productive one. Overall, the relative densities of invertebrates in Movelier and Vicques were only 75% and 60%, respectively, of that in Nenzlingen.

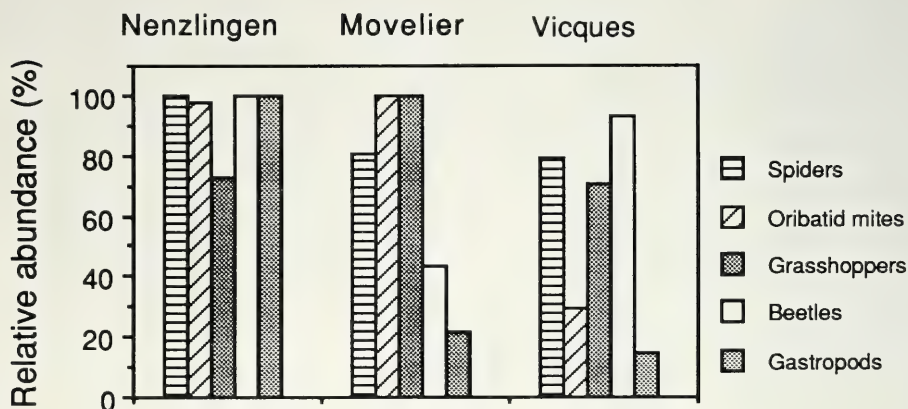


FIG. 3

Relative densities of diverse invertebrate groups at the three investigation sites. The density of each invertebrate group was set equal to 100% at the site where its density was highest.

BETWEEN-SITE DIFFERENCES IN NUMBER OF RARE, ENDANGERED AND THREATENED SPECIES

The relative merits of any sampling technique depend upon its practicality under the given circumstances, particularly in relation to the questions being asked (BOAG 1982). In this study, we determined the species composition and abundances of plant and animal communities without removing any individuals from the experimental areas (except the animals caught with pitfall traps around the experimental blocks and the animals collected in small soil samples). Surely, with more destructive methods we would be able to record a larger number of rare species. Nonetheless, a relatively high proportion of species listed in the Red Data Book of Switzerland were recorded at all three sites. The mean values ranged from 6.7% in ground beetles, 11.2% in terrestrial gastropods, 18.9% in vascular plants, and 28.9% in butterflies to 49.5% in grasshoppers and bush crickets. These figures demonstrate the high conservation value of unfertilized calcareous grasslands in the Jura mountains and demand an appropriate management to maintain (or in some cases even to enhance) species richness.

ACKNOWLEDGEMENTS

We thank numerous students for field assistance and C. Dolt, G. Hofer, S. Liersch and K. Schweizer for technical assistance. H. Turner and T. Meier confirmed some species identifications in gastropods. A. Baur, P. Leadley and J. Niemelä commented on the manuscript. This research is part of the Basel Biodiversity Programme supported by the Swiss National Science Foundation (Priority Programme Environment, Module Biodiversity, grants No. 5001-35241 to B.B., 5001-35221 to

A.E. and 5001-35229 to B.S.). Additional financial support was received from the Amt für Orts- und Regionalplanung, Liestal (Kanton Baselland), the Emilia Guggenheim-Schnurr Stiftung der Naturforschenden Gesellschaft Basel-Stadt and the Freiwillige Akademische Gesellschaft der Universität Basel.

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APPENDIX 1

Percentage of plots in which plant species were present in 1993 and 1994. A total of 40 plots were examined in Nenzlingen, 24 plots in Movelier and 32 plots in Vicques. - indicates the absence of a particular species and asterisks refer to species listed in the Red Data Book of Switzerland (Landolt 1991); 1: Endangered species in northern Jura; 2: Vulnerable species in northern Jura; 3: Rare species in northern Jura.

Species	Nenzlingen		Movelier		Vicques	
	1993	1994	1993	1994	1993	1994
<i>Acer campestre</i> L.	3	-	-	21	38	16
<i>Achillea millefolium</i> L. s.l.	40	30	33	33	41	25
<i>Agrimonia eupatoria</i> L.	45	38	50	42	50	53
<i>Agrostis tenuis</i> SIBTH.	55	50	54	63	72	78

<i>Anthoxanthum odoratum</i> L. s.l.	83	90	13	21	-	3
<i>Bellis perennis</i> L.	53	50	8	8	13	22
<i>Betonica officinalis</i> L.	50	48	67	71	81	78
<i>Brachypodium pinnatum</i> (L.) B.P.	35	18	42	79	53	75
<i>Briza media</i> L.	73	33	58	79	75	81
<i>Bromus erectus</i> HUDSON s.str.	100	100	100	100	97	100
<i>Campanula rotundifolia</i> L.	8	5	21	13	9	13
<i>Carex caryophyllea</i> LA TOURRETTE	60	58	58	88	69	78
<i>Carex flacca</i> SCHREBER	33	55	46	88	69	75
<i>Centaurea jacea</i> L. s.l.	45	40	83	63	81	78
<i>Centaureum erythraea</i> RAFN * 2	3	3	8	-	25	31
<i>Cerastium fontanum</i> BAUMG. s.l.	58	58	29	29	3	9
<i>Chamaespartium sagittale</i> (L.) P. GIBBS	13	13	21	17	81	94
<i>Cirsium acaule</i> SCOP.	55	50	71	71	47	41
<i>Crataegus monogyna</i> JACQ..	20	18	29	33	16	16
<i>Cynosurus cristatus</i> L.	83	25	42	42	44	44
<i>Dactylis glomerata</i> L.	83	48	50	58	38	47
<i>Danthonia decumbens</i> (L.) DC.	45	3	46	29	56	44
<i>Daucus carota</i> L.	13	18	75	83	75	72
<i>Euphorbia cyparissias</i> L.	78	63	8	-	66	59
<i>Fagus sylvatica</i> L.	5	-	8	4	-	6
<i>Festuca ovina</i> L. s.l.	58	58	75	63	59	50
<i>Festuca pratensis</i> HUDSON s.l.	78	8	50	38	3	-
<i>Festuca rubra</i> L. s.l.	38	8	4	-	-	6
<i>Galium album</i> MILLER	8	13	8	13	16	6
<i>Galium verum</i> L.	13	8	21	25	41	47
<i>Helianthemum nummularium</i> (L.) MILLER s.l.	20	23	25	29	25	22
<i>Hieracium pilosella</i> L.	78	75	96	92	94	100
<i>Hippocrepis comosa</i> L.	13	5	13	17	31	13
<i>Hypericum perforatum</i> L.	25	35	38	38	41	47
<i>Hypochaeris radicata</i> L.	50	38	58	63	44	38
<i>Knautia arvensis</i> (L.) COULTER emend. DUBY	48	45	8	8	56	53
<i>Koeleria pyramidata</i> (LAM.) P.B. s.l. * 2	25	13	67	79	63	78
<i>Lathyrus pratensis</i> L.	60	50	33	38	9	6
<i>Leontodon hispidus</i> L. s.l.	40	25	75	75	6	3
<i>Leucanthemum vulgare</i> LAM. s.l.	53	43	88	79	19	13
<i>Linum catharticum</i> L. * 2	33	20	75	79	75	72
<i>Lolium perenne</i> L.	45	8	25	17	16	3
<i>Lotus corniculatus</i> L. s.l.	83	73	71	83	94	91
<i>Luzula campestris</i> (L.) DC.	75	65	17	17	3	9
<i>Medicago lupulina</i> L.	55	30	58	21	28	9
<i>Ononis repens</i> L.	13	8	63	67	72	72
<i>Phleum pratense</i> L. s.l.	10	5	33	42	9	3
<i>Plantago lanceolata</i> L.	78	58	67	75	59	63
<i>Plantago media</i> L.	78	80	79	75	69	63
<i>Poa compressa</i> L.	3	-	13	13	41	6
<i>Poa pratensis</i> L. s.l.	75	55	25	38	25	25
<i>Polygala amarella</i> CRANTZ	3	5	13	13	9	-
<i>Polygala comosa</i> SCHKUHR * 2	20	10	13	25	38	25
<i>Potentilla erecta</i> (L.) RÄUSCHEL	35	23	67	63	16	13
<i>Potentilla neumanniana</i> RCHB.	5	8	63	63	63	63
<i>Potentilla sterilis</i> (L.) GARCKE	60	68	13	17	22	6
<i>Primula veris</i> L. emend. HUDSON s.l.	40	28	42	50	6	9
<i>Prunella grandiflora</i> (L.) SCHOLLER	13	10	42	54	69	78
<i>Prunella vulgaris</i> L.	73	65	54	50	28	16

<i>Prunus spinosa</i> L.	13	8	29	25	22	25
<i>Ranunculus bulbosus</i> L.	95	90	92	96	78	84
<i>Rosa spec.</i>	25	25	13	8	25	28
<i>Sanguisorba minor</i> SCOP.	100	95	92	92	97	97
<i>Scabiosa columbaria</i> L. * 2	23	23	54	42	9	3
<i>Senecio erucifolius</i> L.	50	43	38	29	50	53
<i>Taraxacum officinale</i> WEBER s.l.	50	20	50	21	13	-
<i>Teucrium chamaedrys</i> L.	3	3	50	50	56	50
<i>Thymus serpyllum</i> L. s.l.	30	25	83	92	97	78
<i>Trifolium medium</i> L.	38	35	38	42	66	63
<i>Trifolium montanum</i> L. * 2	35	40	63	54	63	56
<i>Trifolium ochroleucon</i> HUDSON * 2	43	23	63	42	88	66
<i>Trifolium pratense</i> L. s.l.	93	83	67	50	50	16
<i>Trifolium repens</i> L.	70	15	42	8	44	6
<i>Veronica chamaedrys</i> L.	63	63	17	8	16	6
<i>Veronica officinalis</i> L.	30	40	21	13	59	66
<i>Veronica prostrata</i> L. s.l. * 2	3	5	-	4	-	9
<i>Viola hirta</i> L.	30	35	71	83	66	44
<i>Abies alba</i> MILLER	3	-	8	-	-	-
<i>Campanula glomerata</i> L. s.l.* 2	3	3	75	79	-	-
<i>Colchicum autumnale</i> L.	5	10	4	-	-	-
<i>Crepis taraxacifolia</i> THUILL.	10	-	8	4	-	-
<i>Holcus lanatus</i> L.	50	48	-	4	-	-
<i>Orchis morio</i> L. * 1	-	5	4	4	-	-
<i>Orchis ustulata</i> L.	3	3	21	21	-	-
<i>Pinus sylvestris</i> L.	3	3	17	4	-	-
<i>Plantago major</i> L. s.l.	8	3	4	-	-	-
<i>Poa trivialis</i> L. s.l.	33	3	13	29	-	-
<i>Potentilla reptans</i> L.	3	-	4	-	-	-
<i>Quercus robur</i> L.	3	5	8	4	-	-
<i>Rubus spp.</i>	8	8	8	8	-	-
<i>Veronica serpyllifolia</i> L. s.l.	50	45	-	8	-	-
<i>Anthyllis vulneraria</i> L. s.l.	13	13	-	-	25	13
<i>Carpinus betulus</i> L.	20	13	-	-	25	22
<i>Origanum vulgare</i> L.	15	8	-	-	13	9
<i>Pimpinella saxifraga</i> L. s.l.	28	10	-	-	53	19
<i>Salvia pratensis</i> L. * 2	38	28	-	-	53	34
<i>Sedum sexangulare</i> L. emend. GRIMM	8	5	-	-	53	53
<i>Trifolium campestre</i> SCHREBER	35	3	-	-	59	31
<i>Veronica arvensis</i> L.	33	25	-	-	-	3
<i>Vicia sativa</i> L. s.l.	53	60	-	-	9	3
<i>Allium oleraceum</i> L.	-	-	4	-	3	-
<i>Asperula cynanchica</i> L. * 2	-	-	54	54	41	34
<i>Platanthera chlorantha</i> (CUSTER) RCHB. * 2	-	-	13	17	-	3
<i>Ajuga reptans</i> L.	8	5	-	-	-	-
<i>Anemone nemorosa</i> L.	5	5	-	-	-	-
<i>Avenula pubescens</i> (HUDSON) DUMORTIER	33	15	-	-	-	-
<i>Cardamine spec.</i>	-	3	-	-	-	-
<i>Crepis biennis</i> L.	28	-	-	-	-	-
<i>Geranium dissectum</i> L.	20	-	-	-	-	-
<i>Hedera helix</i> L.	-	3	-	-	-	-
<i>Ligustrum vulgare</i> L.	3	3	-	-	-	-
<i>Pteridium aquilinum</i> (L.) KUHN	15	10	-	-	-	-
<i>Ranunculus acris</i> L. s.l.	3	3	-	-	-	-
<i>Rumex acetosa</i> L.	28	23	-	-	-	-

<i>Agrostis stolonifera</i> L.	-	-	21	-	-	-
<i>Alchemilla hybrida</i> agg. * 1	-	-	8	-	-	-
<i>Anacamptis pyramidalis</i> (L.) RICH. * 1	-	-	25	17	-	-
<i>Anthericum ramosum</i> L.	-	-	4	-	-	-
<i>Aster amellus</i> L.	-	-	8	4	-	-
<i>Carex pilulifera</i> L. * 3	-	-	8	29	-	-
<i>Carlina acaulis</i> L. s.l.	-	-	17	-	-	-
<i>Euphorbia verrucosa</i> L. emend. L. * 2	-	-	4	4	-	-
<i>Galium pumilum</i> MURRAY	-	-	8	4	-	-
<i>Gentianella ciliata</i> (L.) BORKH. * 2	-	-	13	-	-	-
<i>Gentiana verna</i> L. * 2	-	-	4	-	-	-
<i>Gentianella germanica</i> (WILLD.)BÖRNER s.l.*2	-	-	21	-	-	-
<i>Gymnadenia conopsea</i> (L.) R.BR.	-	-	25	29	-	-
<i>Orchis militaris</i> L. * 1	-	-	4	4	-	-
<i>Silaum silaus</i> (L.) SCH. et TH. * 2	-	-	17	17	-	-
<i>Sorbus aria</i> (L.) CRANTZ	-	-	-	4	-	-
<i>Spiranthes spiralis</i> (L.) CHEVALLIER * 1	-	-	4	-	-	-
<i>Succisa pratensis</i> MOENCH	-	-	63	58	-	-
<i>Tetragonolobus maritimus</i> (L.) ROTH * 2	-	-	75	88	-	-
<i>Teucrium montanum</i> L.	-	-	8	8	-	-
<i>Thlaspi perfoliatum</i> L.	-	-	25	13	-	-
<i>Vicia cracca</i> L. s.l.	-	-	17	17	-	-
<i>Acinos arvensis</i> (LAM.) DANDY	-	-	-	-	16	6
<i>Convolvulus arvensis</i> L.	-	-	-	-	9	6
<i>Genista tinctoria</i> L. * 2	-	-	-	-	9	6
<i>Gentiana cruciata</i> L. * 1	-	-	-	-	3	3
<i>Juniperus communis</i> L. s.l.	-	-	-	-	3	-
<i>Veronica teucrium</i> L. * 1	-	-	-	-	3	6
<i>Vicia hirsuta</i> (L.) S.F. GRAY	-	-	-	-	19	16
Number of species	108	103	111	100	90	91

APPENDIX 2

Abundance and percentage (in parentheses) of spiders (Aranea) collected at each investigation site in 1994.

Species	Number (%) of individuals collected		
	Nenzlingen	Movelier	Vicques
<i>Alopecosa cuneata</i> (Clerck, 1757)	105 (10.1)	23 (2.7)	69 (8.5)
<i>Alopecosa pulverulenta</i> (Clerck, 1757)	12 (1.2)	7 (0.8)	3 (0.4)
<i>Aulonia albimana</i> (Walckenaer, 1805)	69 (6.6)	97 (11.5)	101 (12.4)
<i>Bianor auROCinctus</i> (Ohlert, 1865)	2 (0.2)	2 (0.2)	1 (0.1)
<i>Cnephalocotes obscurus</i> (Blackwall, 1834)	1 (0.1)	4 (0.5)	3 (0.4)
<i>Drassodes pubescens</i> (Thorell, 1856)	4 (0.4)	3 (0.4)	4 (0.5)
<i>Enoplognatha thoracica</i> (Hahn, 1833)	1 (0.1)	1 (0.1)	1 (0.1)
<i>Eperigone trilobata</i> (Emerton, 1882)	40 (3.8)	51 (6.0)	12 (1.5)
<i>Haptodrassus signifer</i> (C. L. Koch, 1838)	8 (0.8)	7 (0.8)	8 (1.0)
<i>Lepthyphantes tenuis</i> (Blackwall, 1852)	13 (1.3)	16 (1.9)	7 (0.9)
<i>Meioneta beata</i> (O. P. - Cambridge, 1906)	51 (4.9)	27 (3.2)	8 (1.0)
<i>Meioneta rurestris</i> (C. L. Koch, 1836)	10 (1.0)	2 (0.2)	66 (8.1)
<i>Micaria formicaria</i> (Sumdevall, 1831)	1 (0.1)	10 (1.2)	6 (0.7)
<i>Micrargus subaequalis</i> (Westring, 1851)	121 (11.6)	66 (7.8)	49 (6.0)

<i>Myrmarachne formicaria</i> (Degeer, 1778)	2 (0.2)	17 (2.0)	12 (1.5)
<i>Pachygnatha degeeri</i> (Sundevall, 1830)	66 (6.3)	65 (7.7)	3 (0.4)
<i>Pardosa hortensis</i> (Thorell, 1872)	113 (10.9)	3 (0.4)	49 (6.0)
<i>Pardosa pullata</i> (Clerck, 1757)	159 (15.3)	160 (19.0)	5 (0.6)
<i>Pardosa</i> sp.	4 (0.4)	2 (0.2)	1 (0.1)
<i>Phrurolithus festivus</i> (C. L. Koch, 1835)	5 (0.5)	10 (1.2)	2 (0.3)
<i>Pirata latitans</i> (Blackwall, 1841)	1 (0.1)	14 (1.7)	1 (0.1)
<i>Trochosa terricola</i> Thorell, 1856	4 (0.4)	17 (2.0)	8 (1.0)
<i>Walckenaeria antica</i> (Wider, 1834)	6 (0.6)	22 (2.6)	2 (0.3)
<i>Zelotes petrensis</i> (C. L. Koch, 1839)	1 (0.1)	11 (1.3)	13 (1.6)
<i>Zelotes praeficus</i> (L. Koch, 1866)	72 (6.9)	17 (2.0)	19 (2.3)
<i>Zelotes pusillus</i> (C. L. Koch, 1833)	8 (0.8)	1 (0.1)	1 (0.1)
<i>Zora spinimana</i> (Sundevall, 1833)	1 (0.1)	1 (0.1)	1 (0.1)
<i>Bathypantes gracilis</i> (Blackwall, 1841)	1 (0.1)	2 (0.2)	-
<i>Erigone dentipalpis</i> (Wider, 1834)	7 (0.7)	2 (0.2)	-
<i>Euophrys frontalis</i> (Walckenaer, 1802)	5 (0.5)	3 (0.4)	-
<i>Meioneta mollis</i> (O. P. - Cambridge, 1871)	18 (1.7)	18 (2.1)	-
<i>Microneta viaria</i> (Blackwall, 1841)	2 (0.2)	1 (0.1)	-
<i>Pardosa palustris</i> (Linné, 1758)	4 (0.4)	1 (0.1)	-
<i>Pocadicnemis juncea</i> Locket & Millidge, 1953	7 (0.7)	3 (0.4)	-
<i>Tiso vagans</i> (Blackwall, 1834)	3 (0.3)	66 (7.8)	-
<i>Zelotes latreillei</i> (Simon, 1878)	13 (1.3)	2 (0.2)	-
<i>Agelena labyrinthica</i> (Clerck, 1757)	-	1 (0.1)	1 (0.1)
<i>Clubiona neglecta</i> O. P. - Cambridge, 1862	-	4 (0.5)	1 (0.1)
<i>Diplostyla concolor</i> (Wider, 1834)	-	1 (0.1)	1 (0.1)
<i>Euophrys aequipes</i> (O. P. - Cambridge, 1871)	-	1 (0.1)	20 (2.5)
<i>Evarcha arcuata</i> (Clerck, 1757)	-	1 (0.1)	1 (0.1)
<i>Harpactea lepida</i> (C. L. Koch, 1838)	-	1 (0.1)	3 (0.4)
<i>Steatoda phalerata</i> (Panzer, 1801)	-	1 (0.1)	2 (0.3)
<i>Talavera inopinata</i> (Wunderlich, 1993)	-	1 (0.1)	2 (0.3)
<i>Argenna subnigra</i> (O. P. - Cambridge, 1861)	10 (1.0)	-	4 (0.5)
<i>Atypus piceus</i> (Sulzer, 1776)	1 (0.1)	-	3 (0.4)
<i>Episinus truncatus</i> Latreille, 1809	1 (0.1)	-	1 (0.1)
<i>Histopona torpida</i> (C. L. Koch, 1834)	1 (0.1)	-	9 (1.1)
<i>Lepthyphantes pallidus</i> (O. P. - Cambridge, 1871)	1 (0.1)	-	3 (0.4)
<i>Pardosa bifasciata</i> (C. L. Koch, 1834)	13 (1.3)	-	125 (15.3)
<i>Pardosa monticola</i> (Clerck, 1757)	7 (0.7)	-	42 (5.2)
<i>Pisaura mirabilis</i> (Clerck, 1757)	2 (0.2)	-	1 (0.1)
<i>Trochosa robusta</i> (Simon, 1876)	2 (0.2)	-	15 (1.8)
<i>Zelotes pumilus</i> (C. L. Koch, 1839)	4 (0.4)	-	16 (2.0)
<i>Centromerita bicolor</i> (Blackwall, 1833)	1 (0.1)	-	-
<i>Hahnina nava</i> (Blackwall, 1841)	13 (1.3)	-	-
<i>Micaria fulgens</i> (Walckenaer, 1802)	1 (0.1)	-	-
<i>Micaria pulicaria</i> (Sundevall, 1831)	2 (0.2)	-	-
<i>Mioxena blanda</i> (Simon, 1884)	1 (0.1)	-	-
<i>Oedothorax apicatus</i> (Blackwall, 1850)	1 (0.1)	-	-
<i>Oxyptila nigrita</i> (Thorell, 1875)	1 (0.1)	-	-
<i>Oxyptila simplex</i> (O. P. - Cambridge, 1862)	5 (0.5)	-	-
<i>Phrurolithus festivus</i> (C. L. Koch, 1835)	3 (0.3)	-	-
<i>Trochosa ruricola</i> (Degeer, 1778)	12 (1.2)	-	-
<i>Xysticus kochi</i> Thorell, 1872	1 (0.1)	-	-
<i>Xysticus robustus</i> (Hahn, 1832)	1 (0.1)	-	-
<i>Zelotes pedestris</i> (C. L. Koch, 1837)	1 (0.1)	-	-
<i>Zora silvestris</i> Kulczynski, 1897	16 (1.5)	-	-
<i>Alopecosa trabalis</i> (Clerck, 1757)	-	8 (1.0)	-

<i>Bathypantes parvulus</i> (Westring, 1851)	-	1 (0.1)	-
<i>Centromerita concinna</i> (Thorell, 1875)	-	1 (0.1)	-
<i>Clubiona diversa</i> O. P. - Cambridge, 1862	-	1 (0.1)	-
<i>Drassodes cupreus</i> (Blackwall, 1834)	-	3 (0.4)	-
<i>Drassodes lapidosus</i> (Walckenaer, 1802)	-	1 (0.1)	-
<i>Erigone atra</i> (Blackwall, 1841)	-	2 (0.2)	-
<i>Hahnia pusilla</i> C. L. Koch, 1841	-	14 (1.7)	-
<i>Haplodrassus silvestris</i> (Blackwall, 1833)	-	1 (0.1)	-
<i>Lepthyphantes keyserlingi</i> (Ausserer, 1867)	-	3 (0.4)	-
<i>Pardosa prativaga</i> (L. Koch, 1870)	-	1 (0.1)	-
<i>Phrurolithus minimus</i> (C. L. Koch, 1839)	-	15 (1.8)	-
<i>Pocadicnemis pumila</i> (Blackwall, 1841)	-	2 (0.2)	-
<i>Robertus lividus</i> (Blackwall, 1836)	-	1 (0.1)	-
<i>Tapinocyboides pygmaeus</i> (Menge, 1869)	-	1 (0.1)	-
<i>Tegenaria picta</i> Simon, 1870	-	1 (0.1)	-
<i>Tricca lutetiana</i> (Simon, 1876)	-	1 (0.1)	-
<i>Walckenaeria atrotibialis</i> (O. P. - Cambridge, 1878)	-	21 (2.5)	-
<i>Zelotes apricorum</i> (L. Koch, 1876)	-	1 (0.1)	-
<i>Alopecosa accentuata</i> (Latreille, 1817)	-	-	8 (1.0)
<i>Araeoncus humilis</i> (Blackwall, 1841)	-	-	13 (1.6)
<i>Cicurina cicur</i> (Fabricius, 1793)	-	-	1 (0.1)
<i>Cnephalocotes sanguinolentus</i> (Walckenaer, 1837)	-	-	2 (0.3)
<i>Coelotes terrestris</i> (Wider, 1834)	-	-	3 (0.4)
<i>Dipoena coracina</i> (C. L. Koch, 1841)	-	-	4 (0.5)
<i>Dipoena prona</i> (Menge, 1868)	-	-	3 (0.4)
<i>Dysdera erythrina</i> (Walckenaer, 1802)	-	-	4 (0.5)
<i>Gnaphosa lucifuga</i> (Walckenaer, 1802)	-	-	2 (0.3)
<i>Haplodrassus kulczynskii</i> Lohmander, 1942	-	-	6 (0.7)
<i>Harpactea hombergi</i> (Scopoli, 1763)	-	-	1 (0.1)
<i>Neottiura suaveolens</i> (Simon, 1879)	-	-	1 (0.1)
<i>Pelecopsis radicularis</i> (L. Koch, 1875)	-	-	5 (0.6)
<i>Phrurolithus nigrinus</i> (Simon, 1878)	-	-	12 (1.5)
<i>Oxyptila atomaria</i> (Panzer, 1810)	-	-	1 (0.1)
<i>Oxyptila pullata</i> (Thorell, 1875)	-	-	2 (0.3)
<i>Oxyptila scabricula</i> (Westring, 1851)	-	-	3 (0.4)
<i>Scotina celans</i> (Blackwall, 1841)	-	-	2 (0.3)
<i>Xerolycosa nemoralis</i> (Westring, 1861)	-	-	1 (0.1)
<i>Xysticus erraticus</i> (Blackwall, 1834)	-	-	1 (0.1)
<i>Zelotes exiguus</i> (Mueller & Schenkel, 1895)	-	-	36 (4.4)
Total number of individuals	1041	844	816
Number of species	60	63	66

APPENDIX 3

Abundance and percentage (in parentheses) of oribatid mites (Acari, Oribatei) sampled at the margins of the experimental blocks at each investigation site in 1994.

Species	Number (%) of individuals collected		
	Nenzlingen	Movelier	Vicques
<i>Cultroribula bicultrata</i> (Berlese, 1905)	39 (1.8)	17 (1.3)	5 (1.0)
<i>Micropopia minus</i> (Paoli, 1908)	3 (0.1)	28 (2.1)	17 (3.3)
<i>Oppliella nova</i> (Oudemans, 1902)	158 (7.2)	106 (7.8)	69 (13.2)

<i>Peloptulus phaeonotus</i> (C. L. Koch, 1844)	11 (0.5)	67 (4.9)	32 (6.1)
<i>Rhysotritia ardua</i> (C. L. Koch, 1841)	4 (0.2)	12 (0.9)	2 (0.4)
<i>Scheloribates laevigatus</i> (C. L. Koch, 1835)	692 (31.4)	438 (32.3)	27 (5.2)
<i>Tectocephus sarekensis</i> Trägårdh, 1910	45 (2.0)	11 (0.8)	7 (1.3)
<i>Xylobates capucinus</i> (Berlese, 1908)	306 (13.9)	570 (42.1)	261 (49.9)
<i>Eupelops curtipilus</i> (Berlese, 1917)	236 (10.7)	76 (5.6)	-
<i>Minunthozetes semirufus</i> (C. L. Koch, 1840)	253 (11.5)	1 (0.1)	-
<i>Ceratozetes minutissimus</i> Willmann, 1951	129 (5.9)	-	22 (4.2)
<i>Ctenobelba pectiniger</i> (Berlese, 1910)	229 (10.4)	-	26 (5.0)
<i>Fosseremus laciniatus</i> (Berlese, 1905)	13 (0.6)	-	33 (6.3)
<i>Hypochthonius luteus</i> Oudemans, 1917	30 (1.4)	-	5 (1.0)
<i>Suctobelbella palustris</i> (Forsslund, 1953)	-	1 (0.1)	5 (1.0)
<i>Ceratozetes gracilis</i> (Michael, 1884)	15 (0.7)	-	-
<i>Platynothrus peltifer</i> (C. L. Koch, 1840)	15 (0.7)	-	-
<i>Scutovertex minutus</i> (C. L. Koch, 1836)	16 (0.7)	-	-
<i>Suctobelbella sarekensis</i> (Forsslund, 1941)	7 (0.3)	-	-
<i>Brachychthonius berlessei</i> Willmann, 1928	-	1 (0.1)	-
<i>Ceratoppia quadridentata</i> (Haller, 1882)	-	3 (0.2)	-
<i>Epilohmannia cylindrica minima</i> Schuster, 1960	-	9 (0.7)	-
<i>Galumna alata</i> (Hermann, 1804)	-	7 (0.5)	-
<i>Nanhermannia nana</i> (Nicolet, 1855)	-	1 (0.1)	-
<i>Oppiella subpectinata</i> (Oudemans, 1900)	-	2 (0.1)	-
<i>Scutovertex sculptus</i> Michael, 1879	-	5 (0.4)	-
<i>Carabodes labyrinthicus</i> (Michael, 1879)	-	-	1 (0.2)
<i>Cymberemaeus cymba</i> (Nicolet, 1855)	-	-	1 (0.2)
<i>Pergalumna myrmophila</i> (Berlese, 1915)	-	-	2 (0.4)
<i>Suctobelbella subcornigera</i> (Forsslund, 1941)	-	-	6 (1.1)
<i>Suctobelbella tuberculata</i> (Strenzke, 1950)	-	-	2 (0.4)
Total number of individuals	2201	1355	523
Number of species	18	18	18

APPENDIX 4

Abundance and percentage of millipedes (Diplopoda, Myriapoda) collected at each investigation site in 1994.

Species	Number (%) of individuals collected		
	Nenzlingen	Movelier	Vicques
<i>Cylindroiulus caeruleocinctus</i> (Wood, 1864)	38 (100.0)	42 (91.3)	51 (72.9)
<i>Allajulus nitidus</i> (Verhoeff, 1891)	-	1 (2.2)	1 (1.4)
<i>Glomeris hexasticha intermedia</i> Latzel, 1884	-	1 (2.2)	4 (5.7)
<i>Polydesmus denticulatus</i> C. L. Koch, 1847	-	2 (4.3)	-
<i>Glomeris conspersa</i> C. L. Koch, 1847	-	-	2 (2.9)
<i>Glomeris marginata</i> (Villers, 1789)	-	-	3 (4.3)
<i>Glomeris undulata</i> C. L. Koch, 1844	-	-	1 (1.4)
<i>Tachypodoiulus niger</i> (Leach, 1815)	-	-	8 (11.4)
Total number of individuals	38	46	70
Number of species	1	4	7

APPENDIX 5

Abundance and percentage (in parentheses) of grasshoppers, bush crickets and true crickets (Orthoptera: Saltatoria) recorded in the experimental blocks at each investigation site in 1993 and 1994. Figures in italics indicate Saltatoria recorded in the areas surrounding the experimental blocks. Asterisks refer to species listed in the Red Data Book of Switzerland (Nadig & Thorens 1994). (h) indicates that individuals of this species were only heard.

Species	Number (%) of individuals recorded									
	Nenzlingen		1994		1993		Movelier		1994	
	1993	1994	1993	1994	1993	1994	1993	1994	1993	1994
<i>Chorthippus biguttatus</i> (Linné, 1758)	86 (13.1)	68 (9.5)	76 (24.1)	123 (20.6)	36 (6.8)	15 (10.8)	91 (16.8)	94 (18.3)	50 (21.3)	
<i>Chorthippus parallelus</i> (Zetterstedt, 1821)	141 (21.5)	294 (40.9)	101 (32.0)	9 (1.5)	34 (6.4)	27 (19.4)	21 (3.9)	24 (4.7)	44 (18.7)	
<i>Gryllus campestris</i> Linné, 1758 *	14 (2.1)	9 (1.3)	3 (0.9)	9 (1.5)	4 (0.8)	(h)	2 (0.4)	3 (0.6)	(h)	
<i>Metrioptera bicolor</i> (Philippi, 1830) *	123 (18.7)	56 (7.8)	8 (2.5)	13 (2.2)	59 (11.1)	6 (4.3)	29 (5.4)	118 (23.0)	20 (8.5)	
<i>Onoclestes rufipes</i> (Zetterstedt, 1821) *	18 (2.7)	29 (4.0)	26 (8.2)	18 (3.0)	12 (2.3)	7 (5.0)	89 (16.4)	79 (15.4)	26 (11.1)	
<i>Platycleis albopunctata</i> (Goeze, 1778) *	97 (14.8)	24 (3.3)	23 (7.3)	127 (21.3)	59 (11.1)	4 (2.9)	122 (22.5)	65 (12.6)	41 (17.4)	
<i>Stenobothrus lineatus</i> (Panzer, 1796)	153 (23.3)	225 (31.3)	43 (13.6)	162 (27.2)	163 (30.6)	14 (10.1)	153 (28.2)	120 (23.3)	39 (16.6)	
<i>Chrysocraon brachyptera</i> (Oeskey, 1826)	-	3 (0.4)	6 (1.9)	99 (16.6)	149 (28.0)	21 (15.1)	-	-	-	
<i>Gomphoceris rufus</i> (Linné, 1758)	11 (1.7)	8 (1.1)	27 (8.5)	29 (4.9)	8 (1.5)	30 (21.6)	-	-	12 (5.1)	
<i>Tetrix tenuicornis</i> Sahlberg, 1893	11 (1.7)	3 (0.4)	1 (0.3)	2 (0.3)	1 (0.2)	-	-	-	-	
<i>Decticus verrucivorus</i> (Linné, 1758)	-	-	-	1 (0.2)	-	-	35 (6.5)	10 (1.9)	2 (0.9)	
<i>Tettigonia viridissima</i> Linné, 1758	-	-	-	-	5 (0.9)	2 (1.4)	-	1 (0.2)	1 (0.4)	
<i>Metrioptera roselii</i> (Hagenbach, 1822)	3 (0.5)	-	-	-	-	(h)	-	-	-	
<i>Phaneroptera falcata</i> (Poda, 1761) *	-	-	2 (0.6)	-	-	-	-	-	-	
<i>Chrysocraon dispar</i> (Germar, 1831-35) *	-	-	-	-	2 (0.4)	5 (3.6)	-	-	-	
<i>Metrioptera brachyptera</i> (Linné, 1761) *	-	-	-	4 (0.7)	-	-	-	-	-	
<i>Chorthippus dorsatus</i> (Zetterstedt, 1821)	-	-	-	-	-	8 (5.8)	-	-	-	
Total number of individuals	657	719	316	596	532	139	542	514	235	
Number of species	10	10	11	12	12	13	8	9	10	

APPENDIX 6

Abundance and percentage (in parentheses) of ground beetles (Coleoptera, Carabidae) collected at each investigation site in 1994. Asterisks indicate species listed in the Red Data Book of Switzerland (Marggi 1994).

Species	Number (%) of individuals collected		
	Nenzlingen	Movelier	Vicques
<i>Abax parallelepipedus</i> (Piller & Mitt., 1783)	3 (1.9)	1 (1.5)	15 (10.4)
<i>Anisodactylus binotatus</i> (Fabr., 1787)	11 (7.1)	1 (1.5)	3 (2.1)
<i>Calathus fuscipes</i> (Goeze, 1777)	3 (1.9)	15 (22.4)	4 (2.8)
<i>Carabus coriaceus</i> L., 1758	1 (0.6)	1 (1.5)	8 (5.6)
<i>Carabus purpurascens</i> Fabr., 1787	8 (5.2)	11 (16.4)	4 (2.8)
<i>Poecilus cupreus</i> (L., 1758)	3 (1.9)	4 (6.0)	37 (25.7)
<i>Pterostichus ovoideus</i> (Sturm, 1824)	1 (0.6)	2 (3.0)	1 (0.7)
<i>Amara convexior</i> Steph., 1828	8 (5.2)	1 (1.5)	-
<i>Amara lunicollis</i> Schiöde, 1837	25 (16.1)	11 (16.4)	-
<i>Carabus cancellatus</i> Illig., 1798	-	2 (3.0)	1 (0.7)
<i>Carabus monilis</i> Fabr. 1792	-	5 (7.5)	3 (2.1)
<i>Carabus problematicus</i> Herbst, 1786	-	5 (7.5)	5 (3.5)
<i>Pterostichus madidus</i> (Fabr., 1775)	-	1 (1.5)	10 (6.9)
<i>Harpalus dimidiatus</i> (Rossi, 1790)	20 (12.9)	-	12 (8.3)
<i>Amara aenea</i> (De Geer, 1774)	20 (12.9)	-	-
<i>Amara communis</i> (Panz., 1797)	5 (3.2)	-	-
<i>Anisodactylus nemorivagus</i> (Duft., 1812) *	23 (14.8)	-	-
<i>Brachinus explodens</i> Duft., 1812	3 (1.9)	-	-
<i>Nebria brevicollis</i> (Fabr., 1792)	1 (0.6)	-	-
<i>Parophonus maculicornis</i> (Duft., 1812)	12 (7.7)	-	-
<i>Platynus dorsalis</i> (Pont., 1763)	6 (3.9)	-	-
<i>Pterostichus melanarius</i> (Illig., 1798)	1 (0.6)	-	-
<i>Trechus quadristriatus</i> (Schränk, 1781)	1 (0.6)	-	-
<i>Badister bullatus</i> (Schränk, 1798)	-	1 (1.5)	-
<i>Carabus convexus</i> Fabr., 1775 *	-	1 (1.5)	-
<i>Harpalus atratus</i> Latr., 1804	-	1 (1.5)	-
<i>Harpalus latus</i> (L., 1758)	-	2 (3.0)	-
<i>Poecilus versicolor</i> (Sturm, 1824)	-	1 (1.5)	-
<i>Stomis pumicatus</i> (Panz., 1796)	-	1 (1.5)	-
<i>Abax parallelus</i> (Duft., 1812)	-	-	1 (0.7)
<i>Badister meridionalis</i> Puel, 1925	-	-	2 (1.4)
<i>Bembidion quadrimaculatum</i> (L., 1761)	-	-	1 (0.7)
<i>Callistus lunatus</i> (Fabr., 1775)	-	-	6 (4.2)
<i>Carabus auratus</i> L., 1761 *	-	-	10 (6.9)
<i>Harpalus rubripes</i> (Duft., 1812)	-	-	14 (9.7)
<i>Ophonus puncticeps</i> (Steph., 1828)	-	-	2 (1.4)
<i>Panagaeus bipustulatus</i> (Fabr., 1775) *	-	-	4 (2.8)
<i>Pterostichus selmanni</i> (Duft., 1812)	-	-	1 (0.7)
Total number of individuals	155	67	144
Number of species	19	19	21

APPENDIX 7

Butterfly and Zygaenidae species recorded at each investigation site in 1993 and 1994. Asterisks indicate species listed in the Red Data Book (GONSETH 1994) and G refers to species which are closely associated with unfertilized calcareous grasslands.

Species		Nenzlingen		Movelier		Vicques	
		1993	1994	1993	1994	1993	1994
<i>Aglais urticae</i> (Linné, 1758)		+	+	+	+	+	+
<i>Anthocharis cardamines</i> (Linné, 1758)		+	+	+	+	+	+
<i>Argynnis paphia</i> (Linné, 1758)		+	+	+	+	+	+
<i>Brintesia circe</i> (Fabricius, 1775)*	G	+	+	+	+	+	+
<i>Clossiana dia</i> (Linné, 1767)*	G	+	+	+	+	+	+
<i>Coenonympha pamphilus</i> (Linné, 1758)		+	+	+	+	+	+
<i>Colias hyale</i> (Linné, 1758)		+	+	+	+	+	+
<i>Cupido minimus</i> (Fuesslin, 1775)*	G	+	+	+	+	+	+
<i>Cyaniris semiargus</i> (Rottemburg, 1775)	G	+	+	+	+	+	+
<i>Erynnis tages</i> (Linné, 1758)	G	+	+	+	+	+	+
<i>Gonepteryx rhamni</i> (Linné, 1758)		+	+	+	+	+	+
<i>Hipparchia semele</i> (Linné, 1758)*	G	+	+	+	+	+	+
<i>Inachis io</i> (Linné, 1758)		+	+	+	+	+	+
<i>Lasiommata megera</i> (Linné, 1767)	G	+	+	+	+	+	+
<i>Lysandra bellargus</i> (Rottemburg, 1775)	G	+	+	+	+	+	+
<i>Maniola jurtina</i> (Linné, 1758)	G	+	+	+	+	+	+
<i>Melanargia galathea</i> (Linné, 1758)	G	+	+	+	+	+	+
<i>Mellicta parthenoides</i> (Keferstein, 1851)*	G	+	+	+	+	+	+
<i>Papilio machaon</i> (Linné, 1758)	G	+	+	+	+	+	+
<i>Pieris rapae</i> (Linné, 1758)		+	+	+	+	+	+
<i>Pieris brassicae</i> (Linné, 1758)		+	+	+	+	+	+
<i>Polyommatus icarus</i> (Rottemburg, 1775)	G	+	+	+	+	+	+
<i>Pyrgus malvae</i> (Linné, 1758)*	G	+	+	+	+	+	+
<i>Spialia sertorius</i> (Hofmannsegg, 1804)	G	+	+	+	+	+	+
<i>Thymelicus sylvestris</i> (Poda, 1761)	G	+	+	+	+	+	+
<i>Zygaena filipendulae</i> (Linné, 1758)	G	+	+	+	+	+	+
<i>Agriodiaetus damon</i> (Denis & Schiffermüller, 1775)*	G	-	-	+	+	+	+
<i>Aphantopus hyperanthus</i> (Linné, 1758)		-	-	+	+	-	-
<i>Araschnia levana</i> (Linné, 1758)		-	-	+	+	-	-
<i>Aricia agestis</i> (Denis & Schiffermüller, 1775)*	G	-	-	+	+	+	+
<i>Chazara briseis</i> (Linné, 1764)*	G	-	-	+	+	-	-
<i>Coenonympha glycerion</i> (Borkhausen, 1788)*	G	-	-	+	-	-	-
<i>Colias alfacariensis</i> (Ribbe, 1905)	G	-	+	+	+	-	+
<i>Colias crocea</i> (Geoffroy in Fourcroy, 1785)	G	-	+	-	+	-	+
<i>Cynthia cardui</i> (Linné, 1758)		+	-	+	+	+	+
<i>Erebia aethiops</i> (Esper, 1777)*		-	-	+	+	-	-
<i>Hesperia comma</i> (Linné, 1758)	G	-	-	+	+	+	+
<i>Iphiclide podalirius</i> (Linné, 1758)*	G	-	-	+	+	+	-
<i>Leptidea sinapis</i> (Linné, 1758)		-	-	+	+	-	+
<i>Lycaena tityrus</i> (Poda, 1761)	G	-	-	+	+	-	+
<i>Lysandra coridon</i> (Poda, 1761)*	G	-	+	+	+	+	+
<i>Maculinea arion</i> (Linné, 1758)*	G	-	-	+	+	-	+
<i>Melitaea cinxia</i> (Linné, 1758)*	G	-	-	-	+	-	-
<i>Ochlodes venatus</i> (Bremer & Grey 1853)	G	-	+	+	+	+	+
<i>Pieris napi</i> (Linné, 1758)		+	-	+	+	+	+
<i>Plebicula dorylas</i> (Denis & Schiffermüller, 1775)*	G	-	-	+	+	+	+
<i>Thecla betulae</i> (Linné, 1758)		-	-	+	+	-	-
Total number of species		27	30	45	46	35	39

APPENDIX 8

Abundance and percentage (in parentheses) of terrestrial gastropods (Mollusca) recorded in the experimental blocks at each investigation site. + indicates species that were observed on other occasions. Asterisks indicate species listed in the Red Data Book of Switzerland (TURNER *et al.* 1994).

Species	Number (%) of individuals recorded		
	Nenzlingen	Movelier	Vicques
<i>Arion distinctus</i> Mabille, 1868	6 (0.1)	+	+
<i>Arion lusitanicus</i> Mabille, 1868	56 (1.1)	11 (1.7)	3 (0.5)
<i>Cochlicopa lubrica</i> (O. F. Müller, 1774)	112 (2.2)	14 (2.1)	34 (5.6)
<i>Deroceras reticulatum</i> (O. F. Müller, 1774)	3073 (61.4)	336 (50.8)	292 (48.2)
<i>Helicella itala</i> (Linné, 1758) *	190 (3.8)	98 (14.8)	13 (2.1)
<i>Limax</i> spp. (juveniles)	41 (0.8)	1 (0.2)	+
<i>Punctum pygmaeum</i> (Draparnaud, 1801)	20 (0.4)	4 (0.6)	4 (0.7)
<i>Pupilla muscorum</i> (Linné, 1758)	332 (6.6)	23 (3.5)	96 (15.8)
<i>Trichia plebeia</i> (Draparnaud, 1805)	952 (19.0)	141 (21.3)	116 (19.1)
<i>Vallonia pulchella</i> (O. F. Müller, 1774)	8 (0.2)	+	1 (0.2)
<i>Vertigo pygmaea</i> (Draparnaud, 1801)	184 (3.7)	19 (2.9)	39 (6.4)
<i>Vitrina pellucida</i> (O. F. Müller, 1774)	27 (0.5)	11 (1.7)	6 (1.0)
<i>Candidula unifasciata</i> (Poiret, 1801)	+	-	2 (0.3)
<i>Cepaea hortensis</i> (O. F. Müller, 1774)	+	1 (0.2)	-
<i>Helix pomatia</i> Linné, 1758 *	4 (0.1)	2 (0.3)	-
<i>Aegopinella pura</i> (Alder, 1830)	1 (<0.1)	-	-
<i>Vallonia costata</i> (O. F. Müller, 1774)	1 (<0.1)	-	-
<i>Arion ater</i> (Linné, 1758)	+	+	+
<i>Abida secale</i> (Draparnaud, 1801)	+	-	+
<i>Truncatellina cylindrica</i> (Férussac, 1807)	+	-	-
<i>Vitrea contracta</i> (Westerlund, 1871) *	+	-	-
<i>Succinea oblonga</i> Draparnaud, 1801	-	+	-
Total number of individuals	5007 (100)	661 (100)	606 (100)
Number of species	21	16	15

Die räumliche Habitatnutzung einer Dachspopulation (*Meles meles* L.) im schweizerischen Mittelland

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Spatial organization and habitat utilization in a population of European badgers (*Meles meles* L.) in a hilly area of the Swiss midlands.

A small population of European badgers (*Meles meles* L.) was studied between 1977 and 1981. The use of 42 badger dens and of numerous latrines was monitored. The home ranges of 3 radio-collared individuals were surprisingly large, measuring 132, 591 and 438 hectares. The population density was estimated to be only 0.5 individuals/1 km². The use of a wide variety of food resources was observed. Low population density, ranging behaviour and resource utilization did not appear to be obvious consequences of resource availability.

Key-words: European badger - *Meles meles* - Spatial organization - Population density - Sett use - Swiss midlands.

EINLEITUNG

Der Dachs (*Meles meles* L.) galt während langer Zeit als weitgehend solitär lebender Erdmarder mit einem für die meisten Musteliden typischen Raumsystem von innerhalb der Geschlechter nicht überlappenden Aktionsräumen. Erst in den vergangenen 25 Jahren haben intensive Studien in Grossbritannien erkennen lassen, dass der Dachs ein von diesem Schema stark abweichendes Verhalten zeigen kann. Diese Untersuchungen belegten nicht nur die Existenz von in seltenen Fällen bis über 20 Individuen umfassenden Sippen ("clans") mit klar markierten und verteidigten Territorien (KRUUK 1978a, CHEESEMAM *et al.* 1988), sondern liessen auch eine Abhängigkeit der Dachs-Dichte vom Nahrungsangebot (in diesem Falle von Regenwürmern) postulieren (KRUUK 1989). Dass diese Befunde nicht verallgemeinert und nicht unüberprüft auf mitteleuropäische Verhältnisse übertragen werden dürfen, zeigten u.a. die Untersuchungen am Gurten bei Bern im schweizerischen Mittelland. Das dortige superabundante Nahrungsangebot scheint zwar mit klaren saisonalen Unterschieden effizient genutzt zu werden (KISTLER & MISTELI 1984), die Dachsdichte aber lässt sich mit den englischen in keiner Weise vergleichen.

Es war das Ziel der vorliegenden Untersuchung, Einblick in das Raum-Zeit-System der Dachse am Gurten zu gewinnen, unter besonderer Berücksichtigung der Nutzung der Ressourcen Nahrung und Baue. Auf diesem Wege sollten die Unterschiede zu den Verhältnissen in Grossbritannien definiert und Erklärungen für deren Bestehen herausgearbeitet werden.

DAS UNTERSUCHUNGSGEBIET

Dieses grenzt unmittelbar an den südlichen Siedlungsrand der Stadt Bern und liegt in der Hügellzone. Das Gelände steigt von 508 m ü.M. am Aare-Ufer bis zur höchsten Erhebung, dem Gurten, auf 937 m ü.M. Die Fläche des Untersuchungsgebietes beträgt etwa 10 km² (Abb. 1). Im ganzen Perimeter befinden sich nur weiche

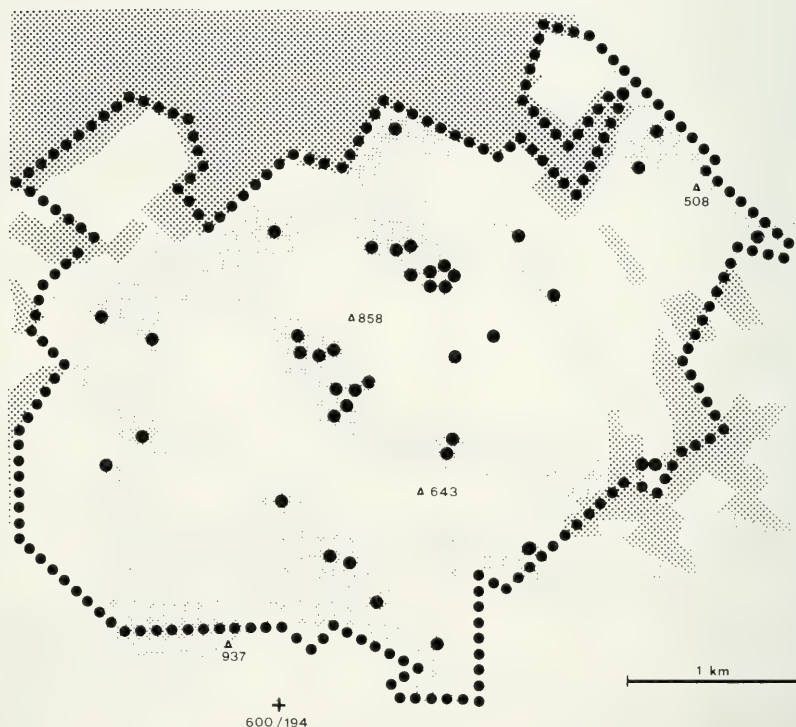


FIG. 1

Lage und Grösse des Untersuchungsgebietes sowie Lage und Verteilung der 42 Dachsbaue. Punktlinie: Untersuchungsperimeter; heller Raster: Wald; dunkler Raster: Siedlung; grosse Punkte: Baue. Situation of the study area and distribution of setts (dots). Dark shading: settlements; light shading: forest.

geologische Formationen, vorwiegend Molasse, Moräne und Schotter. Die Beschaffenheit des Bodens bietet somit den Dachsen günstige Voraussetzungen für das Graben ausgedehnter Höhlensysteme.

Die höheren Lagen waren während der Untersuchungszeit im Winter länger als einen Monat mit Schnee bedeckt. Die Hälfte des Untersuchungsgebietes ist bewaldet, hauptsächlich Laubmischwald mit Fichten (*Picea abies*) und Buchen (*Fagus sylvatica*), das übrige Gebiet wird als Wiese, Weide- und Ackerland (v. a. Weizen, Mais und Kartoffel) genutzt (HEGG 1973, KISTLER & MISTELI 1984).

METHODEN

BAUE, LATRINEN

Baue und Latrinen der Dachse wurden seit 1977 durch regelmässiges Abschreiten des Geländes gesucht und auf ihre Benützung hin mit über die Eingänge gelegten gekreuzten Zweigen und an Hand von Trittsiegeln in Sand, Lehm und Schnee vor den Eingangsröhren kontrolliert. Kotgruben auf landwirtschaftlich intensiv genutzten Flächen wurden wegen der eingeschränkten Begehbarkeit und als Folge ihrer Kurzlebigkeit wohl vielfach nicht erfasst.

DIREKTE UND INDIREKTE BEOBACHTUNG DER DACHSE

Von 1977–80 wurden die nachtaktiven Dachse mit Hilfe eines Infrarot-Nachtsichtgerätes hauptsächlich am Bau beobachtet. Spuren der Nahrungssuche und Trittsiegel ergaben weitere wertvolle Hinweise über die Raumnutzung der Dachse.

1980 und 1981 konnten am Gurten zwei 9 kg schwere Dachsfähen und ein 13 kg schwerer Rüde mit Schlingen gefangen, mit Radiohalsbändern des Typs 294178 B, 148 MHz, entwickelt von D. Burchard (vgl. auch TAYLOR & LLOYD 1978, AMLANER & MACDONALD 1979, CEDERLUND *et al.* 1979, GRAF 1988), ausgerüstet und ihre Aktivität erfasst werden. Fähe Nr 1 liess sich während 7 Monaten, Fähe Nr 2 während 8,5 Monaten und der Rüde lediglich während 1,5 Monaten beobachten. Angaben zu Fangdatum, Anzahl Sendetage, Peilungen und effektiver Beobachtungsdauer sind Tab. 1 zu entnehmen. Durch Direktbeobachtung, ergänzt mit systematisch durchgeführter Überwachung der Baue, konnte zudem die Populationsgrösse von 1977–81 erfasst werden.

BERECHNUNG DER AKTIONSRAUMGRÖSSE UND DER BENUTZUNGSVERTEILUNG

Die Bestimmung der Aktionsraumgrösse erfolgte nach der Gitterzellenmethode (RIEDWYL & SCHÜPBACH 1983) sowie der leicht abgeänderten "Minimum area method" (VOIGT & TINLINE 1980). Bei der Gitterzellenmethode haben wir zur Darstellung absoluter Häufigkeiten auf das Untersuchungsgebiet ein quadratisches Gitternetz, bestehend aus Einzelflächen von 1 ha Grösse, gelegt. Die absolute Häufigkeit wird in die Maschenweite des Netzes abgebildet. Die Häufigkeiten lassen sich durch Auszählen oder Messen der Maschenweite vergleichen. Diese Methode

wurde gewählt, weil die radiotelemetrischen Daten über die Raumnutzung wegen der geringen Individuenzahl statistisch nicht ausgewertet werden können und auch nicht als unabhängige Stichproben betrachtet werden dürfen.

Unter Aktionsraum wird nachfolgend die Summe aller Gitterzellen verstanden, in denen ein radiomarkierter Dachse in den Jahren 1980–81 mindestens einmal beobachtet wurde. Mit dieser Darstellung lassen sich die Aktionsraumgrößen durch Addition der begangenen Flächen, die Schwerpunkte bezüglich Aufenthaltshäufigkeit und die Aufenthaltsdauer pro Flächeneinheit eines Tieres, aber auch die Werte der unterschiedlich lang und nicht zur selben Zeit beobachteten Dachse untereinander vergleichen.

Bei der abgeänderten "Minimum area method" wurde die flächenmässig kleinstmögliche Abgrenzung durch die Verbindung äusserster Beobachtungspunkte vorgenommen und zugleich eine nach ökologischen Kriterien einschränkende Grenzlinie gewählt, indem von markierten Dachsen auch nur teilweise begangene Vegetationseinheiten als ganze Flächeneinheit dem Aktionsraum beigelegt wurden. Allerdings wurden bei Wäldern, die vielfach grosse Ausdehnungen aufweisen, nur die wirklich durch Dachse begangenen Flächen als Aktionsraum miteinbezogen. Hingegen wurden durch Dachse nicht nutzbare Flächen, wie z.B. dicht überbautes Gebiet, nicht in die Flächenberechnungen miteinbezogen. In den vorliegenden Ergebnissen werden dadurch im Vergleich zu den Flächenberechnungen nach der eigentlichen Minimum area Methode wesentlich geringere Flächen nachgewiesen.

PRO NACHT GENUTZTE FLÄCHE

Für die Dachse Nr 1 und Nr 2 wurden die zurückgelegten Wege und die für die Nahrungssuche genutzten Flächen so genau als möglich auf Karten (Massstab 1:10'000) eingezeichnet und ausgemessen. Somit konnte die insbesondere für die Nahrungssuche benötigte Fläche geschätzt und mit der gesamten Aktionsraumgrösse sowie dem verfügbaren Nahrungsangebot pro Fläche in Beziehung gebracht werden (vgl. auch KISTLER & MISTELI 1984).

RESULTATE

DIE AKTIONSRAUMORGANISATION

Lage und Verteilung der Baue

Im 10 km² grossen Untersuchungsgebiet wurden insgesamt 42 Baue gefunden, verteilt über die ganze Fläche (Abb. 1). Ein Bau befindet sich in einer schmalen Hecke, alle übrigen im Wald oder am Waldrand. Von diesen liegen drei Baue ausserhalb der Aktionsräume der radiomarkierten Dachse.

Die Distanz zweier benachbarter Baue beträgt minimal 10 bis maximal 850 m, durchschnittlich 215 m.

*Charakterisierung der Baue***Baugrösse:**

Von den 42 Bauen weisen 31 nur ein bis drei, 10 mehr als sechs und ein Bau 28 Eingangsröhren auf.

Exposition:

Die Baue sind mehrheitlich nach Nordosten und Südwesten ausgerichtet. Diese Exposition wird weitgehend durch den Verlauf des Gurtens und des Ulmizberges von NW nach SE bestimmt.

Hangneigung:

Für 30 Baue weist der Hang Steigungen zwischen 16 und 35% auf, für 4 mehr als 16% und für 8 mehr als 35%. Sehr flache und sehr steile Hänge werden gemieden.

Sichtdeckung, Dickichte in Baunähe:

Bei 29 Bauen fehlte während der Untersuchungszeit eine Deckung bietende Kraut- oder Strauchschicht. Bei 23 Bauen befanden sich in unmittelbarer Nähe Dickichte, welche den Dachsen als bevorzugte Latrinenstandorte dienen konnten.

Distanz zu Waldrand:

Die Entfernungen der sich im Wald befindlichen Baue zum nächsten Waldrand variieren zwischen 1 und 205, durchschnittlich 65 m. Für 33 Baue betragen die Strecken weniger als 100 m, für 24 sogar weniger als 50 m.

TABELLE 1

Angaben zur Beobachtungsdauer der drei radiomarkierten Dachse. Observation times for the three radio-collared badgers.

Dachse	Fangdatum	Letzte Lokalisation	Sendetage	Anzahl Peilungen		Anzahl Peilungen ganze Nacht	Effektive Beobachtungs- dauer
				Tag	Nacht		
Nr 1: ♀	11.09.1980	20.03.1981	191	104	56	5	125h 30'
Nr 2: ♀	22.04.1981	12.12.1981	235	140	67	48	418h 45'
Nr 3: ♂	19.06.1981	31.07.1981	43	13	5	5	56h 15'

Lage, Verteilung und Grösse der durch Dachse benützten Baue

Die 42 erfassten Baue wurden während der Jahre 1977–81 regelmässig bezüglich Benützungshäufigkeit durch Dachse bzw. Füchse kontrolliert. 1980–81 konnte zudem dank der markierten Dachse ihr jeweiliger Übertagungsbaue lokalisiert werden. Die Kontrolle der Baue ergab:

- Vier der 42 Baue wurden nie nachweislich von einem Dachs befahren.
- Insgesamt 35 der 38 befahrenen Baue befinden sich innerhalb der Aktionsräume mindestens eines der drei markierten Dachse.

Für Tier Nr 1 sind es 24, für Nr 2: 34 und für Nr 3: 28 Baue. Von den 35 Bauen haben die radiomarkierten Dachse jedoch nur 15 verschiedene Baue nachweislich benützt (Dachs Nr 1: 7, Nr 2: 12 und Nr 3: 7 Baue; Tab. 2).

TABELLE 2

Anzahl Übertagungen in 15 verschiedenen Bauen durch die radiomarkierten Dachse 1980/81. Fähe Nr 1: 104 Übertagungen, Fähe Nr 2: 139 Übertagungen, Rüde Nr 3: 21 Übertagungen. Days spent in 15 setts by radio-collared badgers in 1980/81. Female no 1: 104 days, female no 2: 139 days, male no 3: 21 days.

Datum	Dachse															Bau-Nr	Total
1980/81	Nr	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Sept.	1	3	4				1					1					9
Okt.	1	9	4			3	3									2	21
Nov.	1	15				7											22
Dez.	1	13															13
Jan.	1	12															12
Febr.	1	11															11
März	1	2	13													1	16
Apr.	2	1	5				1	1						1			9
Mai	2	1	10	2			1	2			1	1					18
Juni	2	3	4	1	3		1	1	3	2	1						19
	3		1	2	1				1								5
Juli	2	2	3	5	5	1				1							17
	3	3	1	9		1			1				1				16
Aug.	2	5	5	5	1		3										19
Sept.	2		7	2			1										10
Okt.	2	3	9		3												15
Nov.	2	9	5	3	4												21
Dez.	2				11												11
Total		92	71	29	28	12	11	4	5	3	2	2	1	1	1	2	264

– Grosse Baue und solche, die sich weniger als 50 m innerhalb des Waldrandes befinden, wurden von den radiomarkierten Dachsen bevorzugt aufgesucht.

– Nur in drei von 24 möglichen Fällen (zwei Dachse gleichzeitig mit Sendern ausgerüstet) verbrachten zwei markierte Dachse miteinander den Tag in demselben Bau.

– Die Baue wurden nicht dauernd bewohnt. Nur für die Winterruhe (Baue Nr 1, 2, 4, 9) oder für die Welpenaufzucht (Bau Nr 2) wurde derselbe Bau während mehr als 6 aufeinanderfolgenden Tagen benutzt!

Lage und Verteilung der Latrinen

Obwohl sicher nur ein Teil der benützten Latrinen erfasst werden konnte (vergl. "Methode"), liessen sich deren 62, bestehend aus einer oder mehreren Kotgruben (bis 30 Kotgruben pro Latrine) verteilt über das ganze Untersuchungsgebiet, finden (Abb. 2). In unmittelbarer Nähe von benützten Bauen treten sie gehäuft auf. Die meisten der 62 Latrinen befinden sich im Sichtschutz von Fichtenaufforstungen (32%), in Dickichten (21%) oder in unmittelbarer Baunähe (Distanz < 20 m ohne Sichtdeckung; 21%). Die restlichen befinden sich im Wald oder am Waldrand in ungedeckter Umgebung (26%). KISTLER & MISTELI (1984) haben durch systematisches Suchen weitere Latrinen, auch ausserhalb des Waldes, gefunden.



FIG. 2

Verteilung der 62 Latrinen (grosse Punkte). Übrige Bezeichnungen vgl. Abb. 1. Distribution of 62 latrines (dots). Other conventions, see Fig. 1.

Aktionsräume der radiomarkierten Dachse

Die Berechnung der Aktionsraumgrössen ergab folgende Werte:

Fähe Nr 1: Die grösste Ausdehnung des Aufenthaltsgebietes in Nord-Süd-Richtung erreicht 2.9 km, in West-Ost-Richtung 2.2 km, die Aktionsraumgrösse 132 ha.

Fähe Nr 2: Die grösste Ausdehnung des Aufenthaltsgebietes in Nord-Süd- und West-Ost-Richtung beträgt 3.7 km, bzw. 4.2 km und die Aktionsraumgrösse 591 ha. Einzelne ausgedehnte Streifzüge erfolgten weit weg vom regelmässig genutzten Aufenthaltsgebiet. Mehrmals konnte die Dachsfähe im dichten Siedlungsgebiet zwischen Häusern bei der Nahrungssuche beobachtet werden!

Rüde Nr 3: Die maximalen Strecken in Nord-Süd- und in West-Ost-Richtung betragen 2.1 km bzw. 3.5 km, die Aktionsraumgrösse 438 ha (Abb. 3).

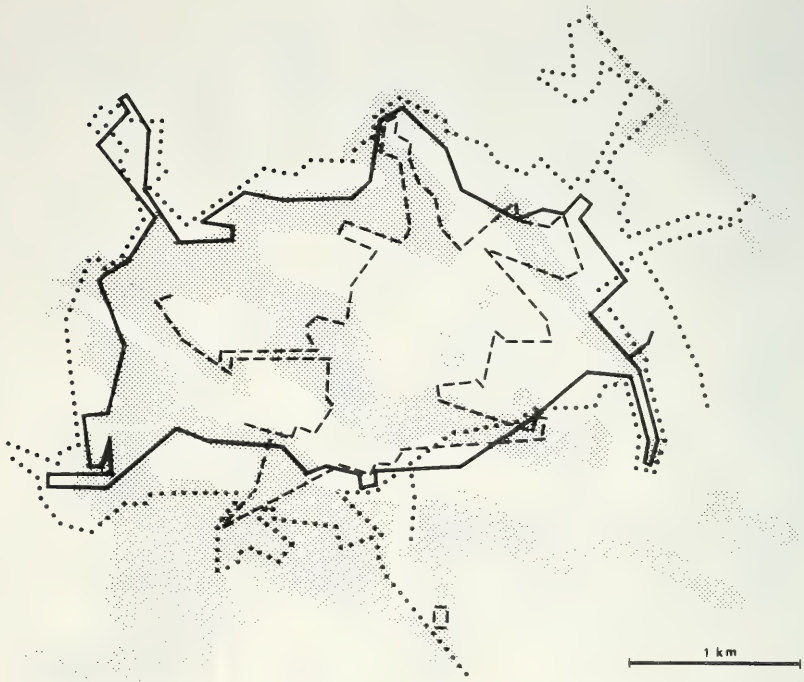


FIG. 3

Aktionsraumgrösse der radiomarkierten Dachse. Heller Raster: Wald; unterbrochene Linie: Aktionsraum der Fähe Nr 1 (130 ha); Punktlinie: Aktionsraum der Fähe Nr 2 (591 ha); ausgezogene Linie: Aktionsraum des Rüden Nr 3 (438 ha).

Home ranges of three radio-collared badgers. Dashed line: female 1 (130 ha); dotted line: female 2 (591 ha); solid line: male (438 ha).

NUTZUNG DES AKTIONSRAUMES

Der Aktionsradius pro Nacht

Für die nachstehende Auswertung standen von den drei markierten Dachsen die Beobachtungen von insgesamt 58 ganzen Nachtaktivitätsperioden zur Verfügung (Dachs Nr 1: 5, Nr 2: 48 und Nr 3: 5 Nächte).

Dabei betrug ihre Aktivitätszeit ausserhalb des Baues von März bis Oktober zwischen 6–11 Stunden (Abb. 4).

Die pro Nacht erfolgten Ortsverschiebungen (ohne Strecken während der eigentlichen Nahrungssuche) variieren im Jahresverlauf, aber auch innerhalb desselben Monats. Die pro Nacht durchschnittlich zurückgelegte Strecke nimmt von Februar bis Mai stark zu, bleibt durch den Sommer relativ konstant und nimmt von

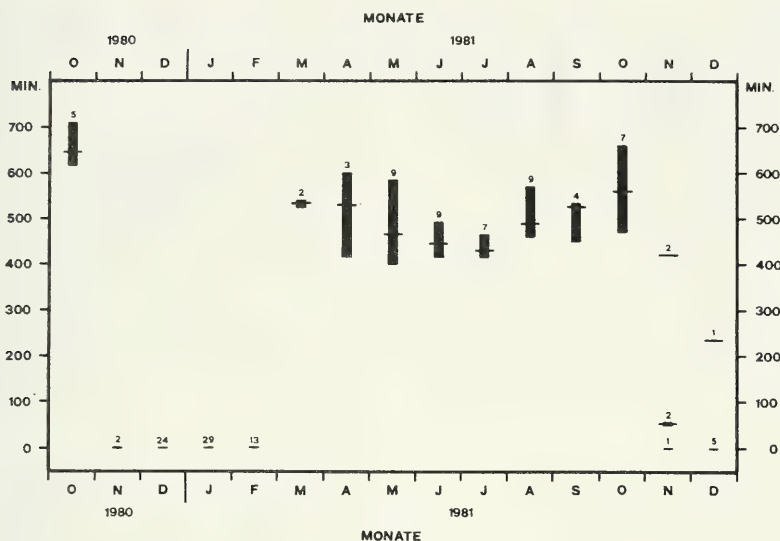


FIG. 4

Nächtliche Aktivitätsperiode der radiomarkierten Dachse im Jahresverlauf (N = 134). Horizontale Linien: Mediane; Balkenenden: Extremwerte; Zahl oberhalb Balkenende: Anzahl Beobachtungsnächte.

Activity period of the radio-collared badgers throughout the year (n = 134 fixes).

Oktober bis Dezember wieder ab. Die zurückgelegten Distanzen betragen zwischen 2 und 11 km pro Nacht (Abb. 5).

Während ihrer nächtlichen Aktivität entfernten sich die markierten Dachse bis maximal 1600 m Luftlinie von dem zuletzt benützten Bau. In der Regel variierte die Entfernung zwischen 350–1005 m. Während der Monate November bis Februar war die Aktivität oft gering. In 26 Nächten konnte aufgrund von Schneespuren festgestellt werden, dass sich die Dachse nur gerade einige Meter vom Bau entfernten und diesen dann nach kurzer Zeit wieder aufsuchten. Dabei liessen sich oft nicht einmal Kot, Harn oder Anzeichen von Futtersuche finden. Aufgrund von Trittsiegeln konnte zudem festgehalten werden, dass Fähe Nr 1 zwischen dem 26.11.1980 und dem 11.2.1981 den Überwinterungsbau in mindestens 56 Nächten nicht verlassen hat!

Pro Nacht genutzte Flächen

Während der Monate März bis Oktober haben die Dachse Flächen zwischen 0.3–17 ha pro Nacht für die Nahrungssuche und die Ortsverschiebungen genutzt. Pro Nacht nutzten sie eine Fläche von durchschnittlich ca. 4 ha.

Die effektiv genutzten Flächen sind somit klein im Verhältnis zum gesamten Aktionsraum von 130 ha (Dachs Nr 1) und 591 ha (Dachs Nr 2). Zahlreiche Flächen wurden im Verlauf des Jahres mehrmals aufgesucht.

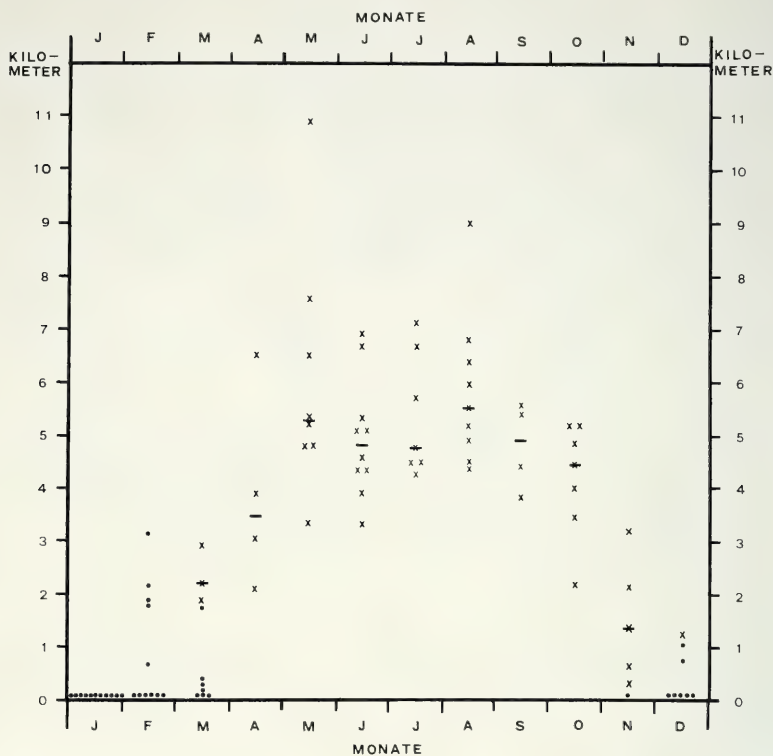


FIG. 5

Pro Nacht zurückgelegte Strecken der beobachteten radiomarkierten Dachse sowie Schneefährten der radiomarkierten und nicht radiomarkierten Dachse (1977–81) im Jahresverlauf. Kreuze: Strecken der radiomarkierten Dachse (58 Beobachtungen); Punkte: Strecken der Schneefährten (38 Beobachtungen); horizontale Linien: Mediane.

Distances travelled per night by the three radio-collared badgers (crosses) and snow tracks (dots) throughout the year.

Zeitliches Verteilungsmuster

Auswertungen mit Hilfe der Gitterzellenmethode zeigen, dass bestimmte Zellen des Gitternetzes unterschiedlich begangen wurden. Zahlreiche Zellen weisen hohe Werte auf (Kerngebiete). Diese befinden sich unregelmässig verteilt, jedoch vorwiegend im zentralen, vereinzelt auch im peripheren Bereich des Aktionsraumes. Das zeitliche Verteilungsmuster variiert auch im Verlauf des Jahres stark. Es ergibt sich durch das örtlich und saisonal genutzte Nahrungsangebot, zeitlichem Aufwand bei der Nahrungssuche, Baubenutzung sowie intraspezifische Kontakte (Abb. 6).

Aufenthalt auf landwirtschaftlich genutzten Flächen und im Wald

Die Aufenthaltsdauer der drei markierten Dachse verteilt sich hauptsächlich auf den Wald (Nr 1: 63%, Nr 2: 54% und Nr 3: 30% der Beobachtungsdauer), das Grünland (Nr 1: 18%, Nr 2: 21% und Nr 3: 25%) sowie Getreide, hauptsächlich Mais

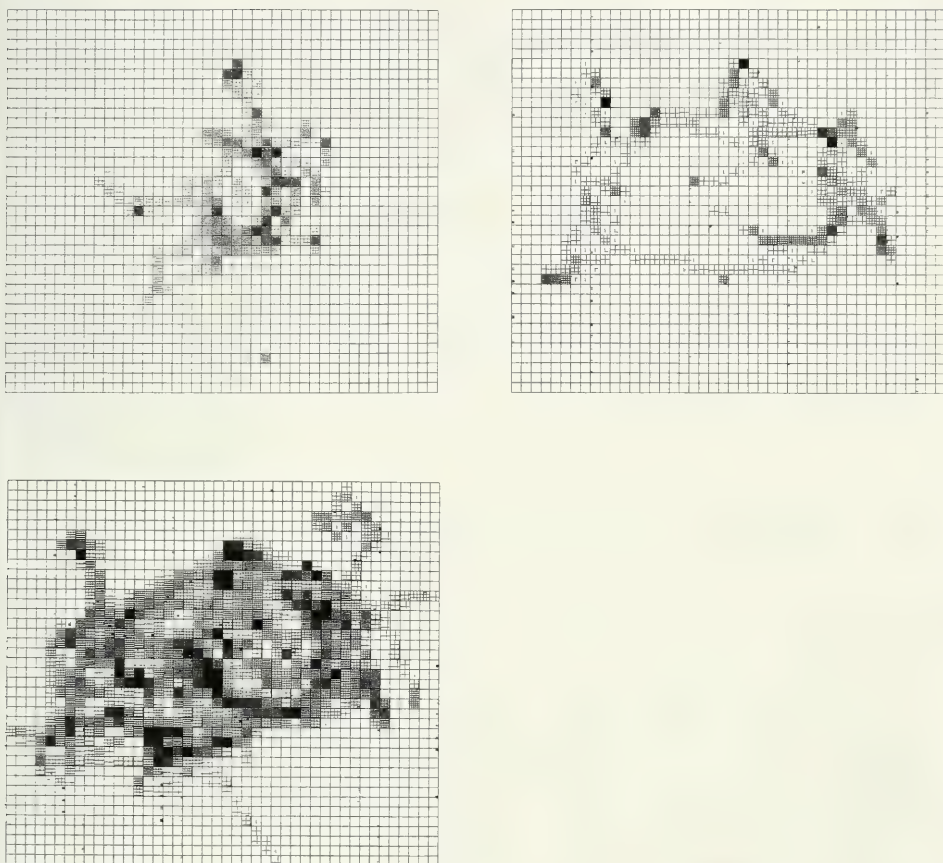


FIG. 6

Zeitliches Verteilungsmuster (Aufenthaltsdauer) der drei radiomarkierten Dachse gemäss Gitterzellenmethode (Riedwyl & Schüpbach 1983): a) Fähe Nr 1: September 1980–März 1981; Beobachtungsdauer: 125h 30'. b) Fähe Nr 2: April 1981–Dezember 1981; Beobachtungsdauer: 418h 45'. c) Rüde Nr 3: Juni 1981–Juli 1981; Beobachtungsdauer: 56h 15'.

Position in time and space of the three radio-collared badgers. a) female 1: September 1980–March 1981. b) female 2: April 1981–December 1981. c) male: June 1981–July 1981.

(Nr 1: 12%, Nr 2: 16% und Nr 3: 36%). Die verbleibende Beobachtungszeit verteilt sich auf verschiedene Nutzungstypen. Eigene Beobachtungen sowie Untersuchungen über das Nahrungsangebot und dessen Nutzung am Gurten durch Kistler & Misteli (1984) ergaben, dass die Dachse hauptsächlich Regenwürmer, Insekten, Schnecken, Eicheln, Buchecker und Getreidekörner frassen. Diese Ergebnisse stimmen mit denjenigen der Nahrungsanalysen in einem 20 km weiter östlich gelegenen Untersuchungsgebiet (STOCKER & LÜPS 1984, ROPER & LÜPS 1995) weitgehend überein.

Populationsgrösse

Folgende Indizien lassen den Schluss zu, dass die Grösse der Dachspopulation innerhalb des intensiv überwachten Untersuchungsgebietes von 1977–81 drei bis maximal fünf adulte Tiere umfasste:

- Die Mehrzahl der Baue wurde während der Beobachtungsperiode nur selten befahren.
- Anstrengungen, weitere Dachse für die Markierung zu fangen, waren erfolglos.
- Unmarkierte Dachse wurden selten beobachtet.
- Nur siebenmal wurde ein unmarkiertes adultes Individuum zusammen mit einem radiomarkierten Dachs begegnet, während zwei markierte Dachse sechsmal zusammen beobachtet wurden.
- Während der Winterruheperioden wurde jeweils nur ein Bau benutzt.
- Während der Beobachtungsperiode konnte nur ein Geheck nachgewiesen werden (1977, 3 Welpen).

Somit betrug die Populationsdichte am Gurten während der ganzen Untersuchungszeit maximal ein Dachs pro 200 ha!

DISKUSSION

Die Aktionsraumgrösse, das Muster der räumlichen und zeitlichen Habitatnutzung, die Grösse und die Dichte der Dachspopulation am Gurten unterscheiden sich wesentlich von denjenigen anderer untersuchter europäischer Dachspopulationen. Da der Intensität der Datenerhebung über einzelne Individuen die Extensität (Ausweitung des Untersuchungsgebietes, Erhöhung der Individuenzahl) zum Opfer fiel, dürfen in der Konsequenz keine allzu weitreichenden Verallgemeinerungen aus den Daten von nur drei verfolgten Individuen gezogen werden. Folgende Bemerkungen scheinen uns jedoch zulässig:

DIE NUTZUNG DER BAUE

Im Untersuchungsgebiet befinden sich zahlreiche grosse Baue, die eine günstige Lage bezüglich Nahrungsressourcen und Schutz vor menschlichen Störungen aufweisen. Alle grossen und häufig benutzten Baue befinden sich im zentralen Bereich der Aktionsräume.

Grosse Baue wurden von den Dachsen gewählt für längere Winterruheperioden und für die nur einmal festgestellte Jungenaufzucht. Die Dachse wechseln den Bau häufig ohne erkennbaren Grund. Viele grosse Baue werden nur selten benutzt. Dies ist wohl auf die geringe Dachsdichte zurückzuführen. Kleine Baue werden durch Dachse regelmässig unterhalten, jedoch selten zur Übertagung aufgesucht. Sie dienen allenfalls als Zufluchtsorte bei überraschenden Störungen (BUTLER & ROPER 1995).

Aufgrund der ständigen Baukontrollen ist anzunehmen, dass die intra- und interspezifische (Füchse) Konkurrenz wahrscheinlich gering war. In Grossbritannien werden unter ungestörten Verhältnissen in der Regel alle Hauptbaue, auch nahe beieinanderliegende, ununterbrochen benützt (C. Cheeseman pers. Mitt., KRUUK & PARISH 1977, NEAL 1977, ROPER 1992).

AKTIONSRAUMGRÖSSE

Die Ergebnisse zeigen, dass die Aktionsräume mit 130, 438 und 591 ha unerwartet gross sind. Zudem überlappen sie sich vollständig. Ähnliche Resultate hat MOUCHES (1981) mit Aktionsraumgrössen von 280–400 ha in Westfrankreich erhalten. Mit 22–147 ha haben CHEESEMAM *et al.* (1981), KRUUK & PARISH (1977) und KRUUK (1978a) sowie HARRIS (1982) in Grossbritannien wesentlich kleinere Aktionsräume erhoben.

POPULATIONSGRÖSSE

Im 10 km² grossen Untersuchungsgebiet hielten sich während der Beobachtungszeit (1977–81) nur maximal 5 adulte Dachse auf. Mit 0.5 Dachsen pro 1 km² ist die Dichte im Vergleich zu der anderer Gebiete sehr niedrig: CHEESEMAM *et al.* (1981 und 1985) erwähnt 5–20, KRUUK & PARISH (1982) 1–6, MOUCHES (1981) 1,5 Dachse pro 1 km². Dabei ist allerdings zu beachten, dass nur langfristige umfangreiche Untersuchungen zuverlässig Auskunft über die für ein Gebiet charakteristische Dichte geben können, da Populationsschwankungen in einem gewissen Umfang zu erwarten sind. Die niedrige Dichte der untersuchten Population kann mit der vorliegenden Untersuchung nicht erklärt werden. Wetterfaktoren als bestandesregulierende Einflüsse in Gebirgsregionen, wie sie EIBERLE & MATTER (1985) postulieren, treffen für das Gurtengebiet (500–900 m ü. M.) kaum zu. Das Nahrungsangebot kann nicht als limitierender Faktor für die geringe Dichte zutreffen: KISTLER & MISTELI (1984) haben auch für den Sommer, wenn die als Hauptnahrung genutzten Regenwürmer ein Populationsminimum aufweisen und häufig schlecht erreichbar sind, gezeigt, dass Nahrungsressourcen superabundant vorhanden sind. Die Untersuchung lässt auch keine Aussagen zu, ob die geringe Dichte auf die Tollwut, welche ab 1979 in der Region Köniz und Gurten aufgetreten ist, und auf die Tollwutbekämpfungsmassnahmen zurückzuführen ist.

HABITATNUTZUNG

Es zeigen sich auch Unterschiede bezüglich Strategien der Habitatnutzung im Vergleich zu den Resultaten von KRUUK (1978a, b) und CHEESEMAM *et al.* (1981). Die Dachse am Gurten nutzen wesentlich grössere Flächen und legen pro Nacht durchschnittlich längere Strecken zurück, obwohl nutzbare Nahrungsressourcen viel näher lägen. KISTLER & MISTELI (1984) gelangten aufgrund ihrer Analysen zum Schluss, dass bezüglich Nahrungsangebot wahrscheinlich ein Aktionsraum von ca. 78–113 ha den maximal fünf Dachsen am Gurten genügen würde, falls sie sich allein von Regenwürmern ernähren würden. Dasselbe gilt auch für andere wichtige Nahrungsressourcen wie Mais. So würde im Herbst ein einzelnes Maisfeld den Dachsen genügend Nahrung bieten. Trotzdem suchten Dachse während derselben Nacht mehrere weit ausein-

anderliegende Maisfelder zur Nahrungssuche auf. Allerdings ist die Nutzungsintensität nicht dieselbe wie in Grossbritannien, wo die Dachse als "Regenwurm-spezialisten" (KRUUK 1989 und KRUUK & PARISH 1981) einige wenige kleine, aber ergiebige Futterplätze ("patches"; KRUUK 1978b), intensiv nach Regenwürmern ab-suchen. Die Dachse am Gurten sind nicht an solche "Regenwurmpatches" gebunden, sondern sind eher als Nahrungsgeneralisten (ROPER 1994) zu betrachten, die ein vielfältiges Nahrungsangebot lokal, jahreszeitlich und individuell mit unterschiedlicher Intensität nutzen (KISTLER & MISTELI 1984).

TERRITORIALITÄT

KRUUK (1978a) sowie KRUUK & PARISH (1982) und CHEESEMAM *et al.* (1981) wiesen nach, dass Dachssippen, bestehend aus 2–12 Dachsen, kleinstmögliche, durch Latrinen und Duftstoffe deutlich von einander abgegrenzte Territorien verteidigen (20–310 ha). Die Grösse der Sippe liess sich zudem mit der Biomasse der Regenwürmer innerhalb eines Territoriums korrelieren. HARRIS (1982) hingegen hat in vorstädtischen Verhältnissen gezeigt, dass Dachse ein breites Nahrungsspektrum nutzen und das territoriale Verhalten nicht so ausgeprägt ist. Dachse unterschiedlicher Sippen suchen ihre Nahrung teilweise in sich überlappenden Gebieten (vgl. CRESSWELL & HARRIS 1988, CHEESEMAM *et al.* 1988).

Die grosse Zahl der Baue mit gelegentlichen Anzeichen von Dachsaktivität hatte uns ursprünglich eine weit höhere Populationsdichte vermuten lassen. Aufgrund der räumlichen Verteilung grosser Baue erschien uns auch eine Aufteilung des Untersuchungsgebietes in mehrere "clan"-Territorien durchaus denkbar.

Trotz der Grösse unseres Untersuchungsgebietes von 10 km² liessen sich nicht mehrere Sippen und Territorien abgrenzen. Unsere telemetrische Studie lieferte keine Hinweise für verteidigte Territorien:

- Die drei mit Sendern ausgerüsteten Dachse bewegten sich in vollständig überlappenden Aktionsräumen. Sie benutzten auch dieselben Baue, allerdings selten gleichzeitig.
- Nur in ganz wenigen Fällen wurden mindestens zwei Dachse bei gemeinsamer Nahrungssuche oder zusammen am Bau beobachtet.
- Aggressivität zwischen sich begegnenden Dachsen wurde nie festgestellt.
- Die Aktionsräume weisen Grenzlängen auf, die sich vermutlich nicht vertei-digen lassen.
- Latrinen wurden hauptsächlich in der näheren Umgebung häufig benutzter Baue ("Hinterland-Latrinen", vgl. ROPER *et al.* 1993), selten an der Peripherie der Aktionsräume gefunden ("Grenz-Latrinen"). Letztere dürften allerdings wegen landwirtschaftlicher Nutzung nur für kurze Zeit Bestand haben und deshalb nicht gefunden worden sein. Dennoch kann die Situation im Sinne Ropers da-hingehend interpretiert werden, dass die in Baunähe genutzten Latrinen in starkem Mass zur gegenseitigen Erkennung und zur Kennzeichnung der Wurf-baue dienen.

Unsere Beobachtungen erwecken den Eindruck, dass die untersuchten Dachse einen riesigen "clan"-Aktionsraum nutzen. In diesem Aktionsraum gibt es keine

markierten Grenzen. Vermutlich wird er auch nicht verteidigt. Wir wissen allerdings nicht, ob und in welcher Form Interaktionen mit Nachbar-Dachsen stattfinden. Eben-
sowenig kennen wir die populationsbiologischen Parameter der Dachse ausserhalb
unseres Untersuchungsgebietes.

Unsere Resultate haben ergeben, dass die Populationsdichte niedrig ist, dass sich
die Tiere in grossen Aktionsräumen bewegen, als Nahrungsgeneralisten ein breites
Nahrungsspektrum in weit entfernten Gebieten nutzen und ein Überangebot an Bauen
besteht. Diese Beobachtungen unterscheiden sich in wesentlichen Punkten von An-
gaben über Populationsdichten und Raum-Zeit-Systeme anderer Dachspopulationen. Im
Falle der Dachse am Gurten stellen weder das Angebot an Bauen oder an den zu deren
Anlage günstigen Strukturen einen limitierenden Faktor dar (vgl. dazu DONCASTER &
WOODROFFE 1993, WOODROFFE & MACDONALD 1992), noch das vorhandene
Nahrungsangebot. Der Umstand der weitgehend fehlenden sozialen Organisation und
das damit in Beziehung stehende räumliche und zeitliche Verhaltensmuster der
einzelnen Tiere (vgl. HARRIS 1982, CHEESEMAM *et al.* 1988, CRESSWELL *et al.* 1992,
ROPER & LÜPS 1993) lassen keine direkten Zusammenhänge zu den oben geannnten
Parametern erkennen. Sie dürften am ehesten eine Folge der geringen Populationsdichte
sein, für die im Falle des Gurtens eine plausible Erklärung allerdings fehlt. Sowohl
bezüglich Nahrung wie auch punkto Sozialverhalten und räumlicher Organisation
erweist sich der Dachs, dies geht aus den zahlreichen Untersuchungen aus ver-
schiedenen Teilen Europas und aus deren Vergleich deutlich hervor, als viel variabelere
Art als dies lange Zeit angenommen worden ist.

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Le zoobenthos comme indicateur des perturbations d'origine humaine dans deux lacs de montagne

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Zoobenthos as indicator of man-made perturbations in two mountain lakes. - In Lake Lioson (Switzerland), chironomid larvae were relatively abundant compared with oligochaetes (mostly *Tubifex tubifex*). In addition, taxa indicative of oligotrophic conditions were present in the profundal (10 - 20 m deep). In contrast, these taxa were absent from Lake Chavonnes and chironomids were scarce. Oligochaetes, which were very abundant at a depth of 12 m, were almost absent deeper than 20 m. Composition and distribution of zoobenthos according to depth were typical for an oligotrophic mountain lake in Lioson, for a eutrophic lake in Chavonnes. Oxygen profiles according to depth and phosphorus concentrations in the water confirmed this interpretation.

Key-words: Biomonitoring - Chironomidae - Eutrophication - Mountain lake - Oligochaeta.

INTRODUCTION

Les lacs de montagne des Alpes sont en général oligotrophes s'ils ne sont pas influencés par l'homme (CHACORNAC 1986). Du fait de la rareté du phosphore, la production primaire reste faible et l'oxygène est abondant à toutes profondeurs, sauf en hiver, ce qui les différencie des lacs de plaine oligotrophes (WETZEL 1975). En effet, la présence d'une couche de glace et de neige, pendant parfois plus de sept mois, empêche les apports atmosphériques. De ce fait, les couches d'eau profondes s'appauvrissent en oxygène vers la fin de l'hiver (moins de 1 mg / l) ce qui entraîne la remise en suspension du phosphore contenu dans le sédiment. Ces phénomènes sont analogues à ceux qui s'observent pendant l'été dans l'hypolimnion des lacs de plaine eutrophes, mais la cause en est différente (CAPBLANCQ & LAVILLE 1983).

Lorsque le phosphore augmente dans les lacs de plaine, la production primaire s'accroît, avec elle la sédimentation organique, d'où une baisse des concentrations en oxygène dans les couches d'eau profonde pendant la phase de stagnation estivale

(WETZEL 1975). La zone profonde des lacs de montagne est donc particulièrement sensible aux effets d'un excès de phosphore d'origine humaine puisqu'elle est déjà exposée à un manque d'oxygène d'origine naturelle. Si les conditions du milieu changent dans cette zone, le zoobenthos, c'est-à-dire les invertébrés qui colonisent le sédiment, va se modifier d'une façon interprétable, d'où son utilisation comme indicateur (Lang 1986).

Dans la présente étude, nous avons utilisé le zoobenthos pour suivre l'évolution à long terme (1978 - 1995) de deux lacs de montagne situés dans les Préalpes vaudoises: le lac Lioson (altitude 1848 m) et le lac des Chavonnes (1690 m). Sur un plan plus général, les résultats obtenus permettent d'évaluer l'utilité du zoobenthos comme indicateur des perturbations d'origine humaine dans un milieu particulier. En effet, les deux lacs étudiés sont couverts de glace et de neige de la mi-novembre à la mi-juin ce qui expose le benthos à des conditions extrêmes (CAPBLANCQ & LAVILLE 1983).

STATIONS ET METHODES

Les lacs étudiés sont relativement profonds (28 m au maximum) par rapport à leur taille modeste (Lioson 6 ha, Chavonnes 4 ha). La pente du fond, forte entre 0 et 22 m de profondeur ne s'atténue qu'à partir de 24 m. Entre 0 et 8 m s'étend un éboulis et les sédiments meubles ne deviennent prépondérants qu'à partir de 10 m, ce qui détermine la profondeur supérieure des stations de prélèvements.

Les prélèvements effectués entre 1978 et 1995 sont présentés dans le tableau 1. A chaque profondeur 5 à 12 carottes de sédiment, couvrant 16 cm² chacune, sont prélevées en plongée. Seul le macrobenthos des sédiments meubles de la zone profonde (10 à 20 m) a été étudié.

En laboratoire, le sédiment est tamisé et le refus du tamis (maille 0.2 mm) est fixé au formol 5%. Les oligochètes et les larves de chironomides, qui constituent l'essentiel de la macrofaune, sont ensuite comptés carotte par carotte puis, pour chaque profondeur, l'abondance moyenne (nombre moyen d'individus / 16 cm²) est calculée (Tab. 1). Pour chaque profondeur, un sous-échantillon d'oligochètes et de chironomides, monté dans un milieu approprié (REYMOND 1994), est identifié jusqu'au niveau du genre ou de l'espèce (Tab. 2). Contrairement aux oligochètes, les chironomides n'ont pas été identifiés chaque année.

Le rapport nombre de chironomides sur nombre de chironomides plus nombre d'oligochètes est utilisé pour décrire l'évolution des lacs (WIEDERHOLM 1980). Ce rapport est d'abord calculé carotte par carotte puis, à partir de ces valeurs individuelles, une valeur moyenne est calculée pour chacun des ensembles comparés (Tab. 3). Une augmentation de la valeur de ce rapport indique une amélioration de l'état du milieu: les chironomides sont en effet moins résistants que les oligochètes au manque d'oxygène. De plus, les taxons de chironomides et d'oligochètes identifiés (Tab. 2) peuvent être classés en deux catégories (SAETHER 1979, LANG 1990): les espèces caractéristiques des lacs oligotrophes, sensibles au manque d'oxygène, et les espèces plus résistantes.

TABLEAU 1

Abondance moyenne (nombre moyen d'individus / 16 cm²) des oligochètes et des larves de chironomides en fonction de la profondeur dans le lac Lioson (L) et le lac des Chavonnes (C). n = nbre total de carottes de 16 cm² prélevées. Dans les colonnes 5 à 12, les espaces blancs correspondent à des profondeurs qui n'ont pas été échantillonnées cette année là.

Année	Mois ¹	Lac	n	Oligochètes Profondeur (m)				Chironomides Profondeur (m)			
				10	12	15	20	10	12	15	20
1978	9	L	18	5.2		13.0	11.7	4.7		0.5	0.2
	8	C	18	12.0		1.7	1.8	3.5		0	0.3
1979	7	L	30	2.2		8.3	5.2	4.5		1.0	0.2
	7	C	29	25.5		9.1	0	1.1		0.6	0
1980	8	L	10	5.0			10.6	0.2			1.2
	8	C	10	12.0			0	1.2			0
1981	8	L	10	10.0			8.0	0.2			0
	8	C	10	9.8			0.2	1.0			0
1984	10	L	10	8.0			11.0	2.2			1.0
	10	C	10	17.6			0	3.4			0
1985	8	L	10	3.2			15.6	8.6			0.2
	9	C	10	10.0			0.2	1.0			0
1986	9	L	12		7.0		4.0		11.5		4.0
	8	C	10	42.1				0.6			
1988	-	L	0								
1989	9	C	6		28.0				0.5		
	-	L	0								
1990	9	C	6		32.3				0.2		
	-	L	0								
1991	9	C	12		44.8			0.9			
	10	L	18	10.5	10.5	15.2		1.7	3.0	1.7	
1992	9	C	12	31.7	44.8			1.0	0.5		
	-	L	0								
1993	9	C	18		18.3	17.0			4.2	1.7	
	8	L	24	0.2	0.7	3.8	15.7	10.2	13.0	8.7	0.5
1995	8	C	24	6.5	23.0	7.8	0	0.3	1.0	0.2	0.3
	8	L	24	1.0	3.3	5.0	10.2	4.5	5.7	8.2	2.0
Total	8	C	24	14.7	8.2	16.8	0.2	4.8	2.5	2.3	0
		L	166	3.1	6.4	9.0	9.9	5.7	5.4	3.6	0.6
		C	199	22.3	29.2	10.3	0.3	1.8	1.6	0.9	0.1
Test de t (Prob.)				0.000	0.000	0.515	0.000	0.000	0.000	0.000	0.000

¹ Mois où les prélèvements de zoobenthos ont été effectués: - pas de prélèvements effectués cette année là.

RESULTATS

A 10 et 12 m de profondeur (Tab. 1, ligne Total), les oligochètes sont beaucoup plus abondants dans le lac des Chavonnes que dans le lac Lioson; à 15 m de profondeur, les abondances sont égales; à 20 m de profondeur, elles sont plus élevées dans le lac Lioson. De ce fait, l'abondance des oligochètes augmente avec la profondeur dans le lac Lioson tandis que, au contraire, elle diminue dans le lac des Chavonnes. Dans les deux lacs, c'est *Tubifex tubifex* qui constitue l'essentiel des communautés d'oligochètes (Tab. 2).

TABLEAU 2

Composition du zoobenthos en fonction de la profondeur dans le lac Lioson (L) et dans le lac des Chavonnes (C). Chironomides: taxons 1 - 8, oligochètes: taxons 9 et 10. Taxons présents en 1993 ou en 1995 (+), présent en 1993 et en 1995 (*).

Code	Taxons	Lac	Profondeur (m)			
			10	12	15	20
1	<i>Procladius</i>	L	*	*	*	*
		C	+	*	+	
2	<i>Brillia</i>	L	+			
		C				
3	<i>Heterotrissocladius</i> ¹	L	*	*	*	
		C				
4	<i>Chironomus</i>	L	+	*	+	+
		C	+	+	+	
5	<i>Dicrotendipes</i>	L				
		C	+	*	*	+
6	<i>Paracladopelma</i> ¹	L	+	*	+	+
		C				
7	<i>Tanytarsus</i>	L	*	*	*	*
		C				
8	<i>Paracladius</i>	L	+			
		C				
9	<i>Tubifex tubifex</i>	L	*	*	*	*
		C	*	*	*	*
10	<i>Stylodrilus heringianus</i> ¹	L	*	*		
		C				
	Nbre de taxons	L	9	7	6	5
		C	4	4	4	2

¹ taxons caractéristiques des lacs oligotrophes (Saether 1979, Lang 1990).

TABLEAU 3

Evolution à long terme (1978/79 comparée à 1993/95) du zoobenthos dans le lac Lioson (L) et le lac des Chavonnes (C). Nombre moyen d'individus par 16 cm². Signification statistique des résultats de l'analyse de variance (* effet significatif, *** très significatif, NS non significatif). A x P: interaction année par profondeur. Profondeurs utilisées: 10, 15, 20 m.

Taxons	Lac	Périodes comparées		Signification		
		78/79 ¹	93/95 ²	Année	Profondeur	A x P
Oligochètes (nombre)	L	7.00	5.97	NS	***	***
	C	9.34	7.66	NS	***	***
Chironomides (nombre)	L	1.85	5.67	***	***	***
	C	0.85	1.33	NS	***	NS
Oligochètes + Chironomides (nombre)	L	8.85	11.64	*	NS	NS
	C	10.19	9.00	NS	***	***
Chironomides/Oligochètes + Chironomides (%)	L	23.1	57.2	***	***	***
	C	8.2	13.6	NS	NS	NS

¹ Nombre de carottes: 48 (L) et 47 (C), ² 36 et 36.

A toutes les profondeurs, les larves de chironomides sont plus abondantes dans le lac Lioson que dans le lac des Chavonnes; dans les deux lacs, leur abondance décroît avec la profondeur (Tab. 1). Les chironomides sont moins abondants que les oligochètes, sauf dans le lac Lioson à 10 m de profondeur.

Le nombre total des taxons de chironomides et d'oligochètes est plus élevé dans le lac Lioson que dans celui des Chavonnes, ceci à toutes les profondeurs étudiées (Tab. 2). De plus, trois taxons caractéristiques des lacs oligotrophes, présents dans le lac Lioson (l'un d'eux jusqu'à 20 m de profondeur), n'ont pas été trouvés dans le lac des Chavonnes.

Entre 1978 et 1995 (Tab. 3), l'abondance des oligochètes reste la même dans les deux lacs. Dans le lac des Chavonnes, l'abondance des chironomides ne change pas, elle augmente au contraire dans le lac Lioson. De ce fait, la valeur du rapport chironomides sur chironomides plus oligochètes augmente dans ce dernier lac.

Les taxons de chironomides présents dans les deux lacs en 1993 et 1995 (Tab. 2) sont les mêmes que ceux observés en 1984 et 1985 (LODS-CROZET 1989), à l'exception de *Prodiamesa* qui n'a pas été trouvé dans le lac Lioson en 1993/95.

Le phosphore est plus concentré dans le lac des Chavonnes que le lac Lioson (Fig. 1). L'oxygène diminue fortement avec la profondeur dans le premier lac, d'une façon bien moins accentuée dans le deuxième lac.

DISCUSSION

D'après les concentrations en phosphore (Fig. 1), le lac des Chavonnes est plus productif que le lac Lioson (WETZEL 1975). La composition du zoobenthos confirme ce diagnostic: absence des espèces oligotrophes, rareté des chironomides, abondance élevée des oligochètes à faible profondeur (Tab. 1, 2). Cette productivité accrue entraîne une baisse des concentrations d'oxygène en profondeur (Fig. 1). De ce fait, le zoobenthos devient rare dans les sédiments profonds.

L'aspect des sédiments montre également que le lac des Chavonnes est parfois exposé à un manque d'oxygène. Entre 15 et 18 m de profondeur, le sédiment noir et fluide est recouvert d'un feutrage blanc, presque continu, constitué principalement de bactéries filamenteuses du cycle du soufre (*Beggiatoa*). Celles-ci prolifèrent dans la zone de transition entre un sédiment anoxique et une eau surnageante suffisamment oxygénée: l'un leur fournit l'hydrogène sulfuré, l'autre l'oxygène indispensables à leur développement (JORGENSEN 1977). L'observation en plongée de l'étendue de la zone occupée par *Beggiatoa* permet de surveiller l'évolution du lac. En effet, la limite inférieure de cette zone (18 - 20 m) correspond à la limite supérieure de la région du lac (20 - 28 m) impropre à la vie du zoobenthos (Tab. 1).

Dans le lac des Chavonnes, les concentrations en phosphore ne sont relativement élevées qu'en profondeur, dans les couches d'eau où l'oxygène est rare (Fig. 1). Cette particularité suggère que le phosphore du sédiment est périodiquement remis en suspension dans l'eau (WETZEL 1975). Cet apport interne dépasse probablement en importance les apports externes qui semblent d'ailleurs maîtrisés dans le bassin versant des deux lacs (Ph. Vioget, comm. pers.). Le lac des Chavonnes subit ainsi les effets d'un excès de phosphore provenant de pollutions passées.

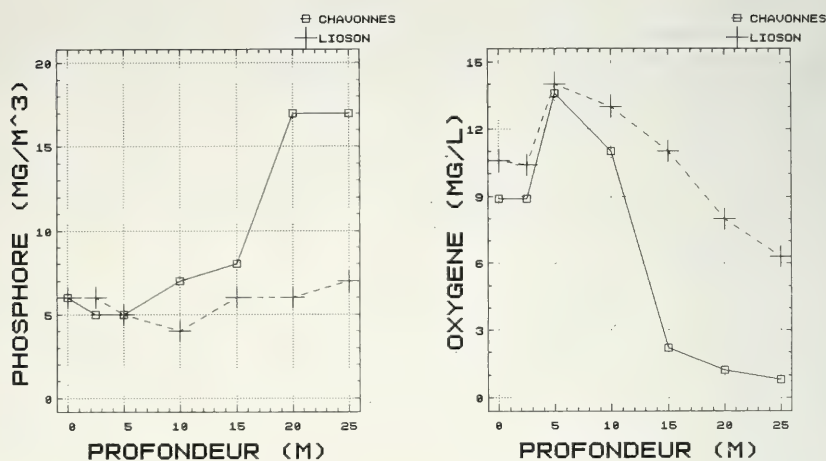


FIG. 1

Concentrations de l'oxygène et du phosphore total en fonction de la profondeur dans l'eau du lac Lioson et du lac des Chavonnes en août 1995. Résultats obtenus par le laboratoire du service des eaux et de la protection de l'environnement (Ph. Vioget, comm. pers.).

Certains indices laissent supposer que des apports en phosphore provenant des vaches, qui paissent l'été à proximité du lac Lioson, pourraient altérer la qualité de ses eaux. Signalons d'abord des amas d'algues filamenteuses vertes dans le littoral proche de la zone la plus fréquentée par le bétail. Ensuite la baisse de l'oxygène en-dessous de 4 mg / l entre 22 et 26 m de profondeur en octobre 1991 (J.F. Rubin, comm. pers.) qui révèle que le lac devient plus productif. Dans le bassin versant du lac des Chavonnes, le problème du bétail se pose en termes analogues, mais la menace est moindre puisque le milieu est déjà altéré.

Le zoobenthos du lac Lioson ressemble à celui des lacs de montagne à l'abri des influences humaines. Dans un lac autrichien (Vorderer Finstertaler See) situé à 2200 m d'altitude, trois espèces d'oligochètes sont relativement abondantes: *Stylodrilus heringianus*, *Spirosperma ferox* et *Tubifex tubifex* (WAGNER 1975). L'abondance des deux premières espèces, caractéristiques des lacs oligotrophes, tend à diminuer entre 5 et 25 m de profondeur tandis que celle de la troisième espèce, qui est aussi la plus abondante, augmente avec la profondeur. Dans ce même lac (BRETSCHKO 1975), les larves de chironomides sont prépondérantes sur les pentes (5 - 15 m), les oligochètes (surtout *Tubifex tubifex*) dans la plaine centrale (25 - 28 m de profondeur).

Dans le lac de Port-Bielh, Pyrénées centrales (altitude 2300 m), les chironomides dominent entre 7 et 13 m de fond (63 - 85% du macrozoobenthos) tandis que les oligochètes deviennent prépondérants entre 14 et 19 m (CAPBLANCQ & LAVILLE 1983). Dans cette zone, *Tubifex tubifex* remplace progressivement *Pelosclex pyrenaicus*, *Chironomus plumosus* remplace *Tanytarsus bathophilus*. La faune des lacs

eutrophes supplante celle des lacs oligotrophes à cause du déficit hivernal en oxygène qui affecte surtout la zone la plus profonde.

Le zoobenthos du lac Lioson, de par sa composition et sa répartition en fonction de la profondeur (Tab. 1, 2), correspond dans les grandes lignes à celui des deux lacs oligotrophes présentés ci-dessus. Le zoobenthos du lac des Chavonnes ressemble à celui observé dans la zone la plus profonde du deuxième lac. D'après ces résultats, le lac Lioson est resté oligotrophe, mais le lac des Chavonnes est devenu eutrophe. Les concentrations en phosphore et les profils verticaux de l'oxygène en été confirment cette interprétation (Fig. 1).

Le prélèvement du zoobenthos à différentes profondeurs et la détermination du rapport chironomides sur chironomides plus oligochètes (Tab. 3) constituent une surveillance simple puisqu'elle n'exige aucune identification poussée des organismes. L'augmentation de ce rapport de 23% à 57% entre 1978 et 1995 indique que l'état du lac Lioson s'améliore tandis que celui du lac des Chavonnes ne change pas (Tab. 3). Toutefois, la valeur du rapport chironomides sur chironomides plus oligochètes peut diminuer sous l'influence d'un facteur purement saisonnier: l'émergence en masse des chironomides après le dégel. Cette baisse ne correspond donc pas à une aggravation de l'état du lac. Pour diminuer l'influence de ce phénomène, les deux lacs comparés ont été visités, dans la plupart des cas, à moins de quinze jours d'intervalle.

Une surveillance plus poussée nécessite l'identification du zoobenthos jusqu'au niveau du genre ou de l'espèce (Tab. 2). En ce qui concerne les taxons indicateurs de conditions oligotrophes, les chironomides remplissent mieux ce rôle que les oligochètes, dans le lac Lioson tout au moins. Ils sont en effet capable de coloniser (ou de recoloniser) les sédiments profonds (10 - 20 m), contrairement à l'oligochète *Stylodrilus heringianus*, qui reste cantonné à 10 - 12 m de fond. Cette situation pourrait aussi indiquer que le lac Lioson a déjà subi un début d'eutrophisation qui limite la distribution verticale de cette espèce, plus sensible que les chironomides à une modification des sédiments ou moins capable de les recoloniser (WIEDERHOLM 1980).

En conclusion, les lacs de montagne qui, de part leur localisation, devraient constituer des milieux protégés, sont soumis à de multiples influences d'origine humaine. Il importe donc de suivre leur évolution à long terme. L'analyse de la composition et de la répartition du zoobenthos en fonction de la profondeur permet d'atteindre cet objectif d'une façon relativement simple.

REMERCIEMENTS

Les commentaires pertinents de Philippe Richoux nous ont permis d'améliorer ce texte.

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Über die Verbreitung der Mauthner Axone bei Fischen und Amphibien und ihren Zusammenhang mit der Schreckreaktion der Ostariophysi und Anura *

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The distribution of the Mauthner axons in fish and amphibians and its relation to the fright reaction in Ostariophysi and Anura. - Mauthner neurons were found in 165 of the 200 families of fish studied. They are absent in most Elasmobranchii, all Anguilliformes, several marine bottom-dwelling fishes, and many others. Mauthner axons during phylogeny have been lost independently in more than a dozen groups of fish. While Loricariidae possess the Mauthner axons and the Mauthner-initiated startle response, both are absent in Aspredinidae, although these are also bottom-dwelling, night-active catfish. No Mauthner axons could be found in *Gymnotus carapo* and *Carapus acus*. This indicates that Mauthner neurons are absent in species in which the caudal motoric system is reduced or lacking. The Mauthner-initiated startle response has been investigated in *Ancistrus dolichopterus* (Loricariidae). There is no difference between a startle response during the day under light conditions and a startle response during the night in complete darkness. The Mauthner-initiated startle response differs fundamentally from a normal turning movement by its enormous speed: in the Mauthner-initiated startle response, the angular velocity is 5300 degrees/s and the displacement speed 20 body lengths/s; in the normal turning movement 700 degrees/s and 3 body lengths/s. All ostariophysean species having epidermal alarm substance cells possess Mauthner axons as well. This is in accordance with the fact that the fright reaction elicited by the alarm substance in Ostariophysi always begins with a Mauthner-initiated startle response. In amphibians the situation is completely contrary. The tadpoles of Bufonidae are the only amphibians possessing a fright reaction elicited by the alarm substance from conspecifics, and they are the only ones lacking Mauthner axons.

Key-words: fish - amphibians - Mauthner neuron - Mauthner-startle response - alarm substance cells - fright reaction - Ostariophysi - *Ancistrus dolichopterus* (Loricariidae).

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*In memoriam Prof. Dr. Ernst Hadorn.
Manuskript angenommen am 13.05.1996.

EINLEITUNG

1859 entdeckte Ludwig Mauthner zwei Riesenaxone im Rückenmark vom Hecht (*Esox lucius* L.). Sie tragen heute seinen Namen und sind Besitz der meisten Fische und Amphibien bzw. deren Kaulquappen. Die beiden Mauthner Zellen befinden sich nahe der Eintrittsstelle des Nervus vestibularis (MAYSER 1881). Sie liegen als paarige große Nervenzellen lateral vom Fasciculus longitudinalis medialis im Boden des 4. Ventrikels. Ihr Soma hat bis zu 100 µm Durchmesser. Jede Mauthner Zelle besitzt neben einer Anzahl kleinerer Dendriten einen großen Ventral- und Lateraldendriten. Der laterale Dendrit zieht fast ohne Verzweigung caudolateral zum VIII. Hirnnerven (Deiters'scher Kern). Der ventrale Dendrit verläuft in cranio-ventraler Richtung und endet innerhalb des Nucleus motorius tegmenti (OTSUKA 1962). Das myelinisierte Axon übertrifft an Größe alle anderen Rückenmark-Axone der Fische. Kennzeichnend ist eine Neuropile („axoncap“), die den unmyelinisierten Axonanfang und den Axonhügel umgibt (ZOTTOLI 1978b). Ranvier'sche Schnürringe fehlen. In unregelmäßigen Abständen gibt es Schmidt-Lantermann'sche Inzisuren, die schraubenförmig von außen nach innen verlaufen (CELIO 1976). Das Axon tritt dorsal in der Mitte aus dem Soma und zieht medial zur Mittellinie der Medulla. Hier kommt es zur Überkreuzung der korrespondierenden Mauthner Axone (DIAMOND 1971). Sie verlaufen dann caudad im Fasciculus longitudinalis medialis ventral des Zentralkanals (SCHWARTZ 1975). Die Verbindung zur Rumpf- und Schwanzmuskulatur geschieht über Kollateralen, die an die Dendriten der ipsilateralen motorischen Vordersäulenzellen gehen (KIRSCHKE 1967). Die am Soma des Dendriten und am Axonhügel ankommenden afferenten Endigungen stammen aus: Fasern des VIII. Gehirnnerven, Nucleus vestibularis, Tractus cerebellotegmentalis, Nucleus principalis trigemini, Nucleus des Nervus lateralis posterior, Mesencephalon und Tectum opticum (BARTELMEZ 1915, RETZLAFF 1957).

DIAMOND (1971) beschreibt die Mauthner Reaktion, ausgelöst durch eine Erregung aus Vestibularapparat oder Seitenlinienorgan über den Nervus statoacusticus, als eine kraftvolle Kontraktion der Rumpf- und Schwanzmuskulatur auf der kontralateralen Seite der aktivierten Zelle. Als eindeutige physiologische Identifizierung der Mauthner Zelle wird ein durch direkte Reizung des Axons hervorgerufenes negatives Potential angesehen. Es läßt sich in unmittelbarer Nähe der erregten Zelle nachweisen. Elektrische Synapsen zwischen dem ipsilateralen Nervus statoacusticus und der Mauthner Zelle, sowie eine Leitungsgeschwindigkeit von 70-100 m/s (die höchste im Rückenmark der Teleostei) garantieren eine kurze Latenzzeit (FABER & KORN 1978). Beide Augen, der Unterkiefer und beide Kiemendeckel werden während der Aktivierung einer Mauthner Zelle bewegt (Schwartz 1975). Bei synchroner Erregung beider Mauthner Zellen kommt es zu keiner Reaktion wegen zweier kollateraler Hemmechanismen, einem chemisch postsynaptischen und einem elektrischen durch Hyperpolarisation (FABER & KORN 1975).

Die biologische Bedeutung der Mauthner Reaktion liegt in der Flucht vor Räubern, z.B. einem herabstoßenden Vogel. Durch die schnelle Körperkrümmung springt der Fisch blitzartig zur Seite und wird vom Angreifer verfehlt. Die durch den

Schreckstoff ausgelöste Schreckreaktion der Ostariophysi (VON FRISCH 1938, 1941a, b, PFEIFFER 1960, 1963, 1967) beginnt stets mit einer Mauthner Reaktion (Pfeiffer *et al.* 1986). Das Vorkommen der Mauthner Axone ist für viele Fische beschrieben, doch fehlt eine Übersicht. Aufgabe war es erstens die Verbreitung der Mauthner Axone zu studieren. Zweitens wird eine Übereinstimmung im Vorkommen von Mauthner Axonen und der Schreckreaktion (bzw. der epidermalen Schreckstoffzellen) bei Ostariophysi geprüft. Drittens wird das durch einen akustischen Reiz ausgelöste Verhalten von Fischarten mit und ohne Mauthner Axone verglichen.

MATERIAL UND METHODEN

Es wurde je eine Liste über das Vorhandensein (Tabelle 1) und über das Fehlen (Tabelle 2) von Mauthner Axonen bei Fischen und Amphibien erstellt. Zur Ergänzung der Literaturdaten wurden 51 weitere, ausgesuchte Fischarten aus 38 Familien lichtmikroskopisch auf das Vorhandensein von Mauthner Axonen geprüft. Die Fische wurden mit MS 222 getötet und 24 h in Bouin fixiert. Die herauspräparierte Wirbelsäule wurde 3-5 Tage in EDTA (Romeis 1968) entkalkt. Eingebettet wurde in Paraffin über Isopropanol. Die 10 μ m Schnitte wurden mit HE gefärbt, mikroskopiert und fotografiert (Agfachrom CT 100i; ISO 100/21°).

Bei den Welsarten *Ancistrus dolichopterus* (Kner, 1854) (Loricariidae), *Dysichthys coracoideus* (Cope, 1874) und *Bunocephalichthys verrucosus* (Bloch, 1794) (Aspredinidae) wurde versucht durch akustische Reizung die Mauthner Reaktion auszulösen. Die Registrierung erfolgt durch Videoaufnahmen senkrecht von oben (Abb. 1). Videoanlage:

Recorder	Panasonic NV-FS 200 EG
Videokassetten	BASF Premium High Grade E-240
Tag- (2) und Nachtkamera (1)	Hitachi CCTV Model HV 17AE
Objektiv jeweils	Zoom 16-100 mm (1:1,9)
Restlichtverstärker	Nocton VS/N : 115
Timer	FOR.A.Ltd Model VGT

Für die Auswertung wurden Einzelbilder ausgemessen. Das zeitliche Auflösungsvermögen der Anlage betrug 1/50 s. Der Timer registrierte Datum und Uhrzeit (1/100 s). Von 8-20 Uhr waren zwei 20 W Leuchtstoffröhren eingeschaltet. Für die Nachtaufnahmen dienten eine IR-Lichtquelle (IR 840 E), eine IR-Folie unter dem Aquarium-Glasboden und ein Restlichtverstärker vor dem Objektiv der Nachtkamera. Die durchschnittliche Beleuchtungsstärke war 22,57 μ W/cm². Die Wände des 50 x 40 cm Versuchsaquariums waren mit Folie abgeklebt, so daß die Welse keine visuellen Informationen von außen erhalten konnten. Der Wasserstand betrug 15 cm, die Temperatur 23 °C. Bei *Ancistrus dolichopterus* wurde ein Gitter ca. 2 cm von den Aquarienwänden entfernt eingebaut um zu verhindern, daß sich der Wels dort festsaugt, was eine Auswertung der Aufnahmen unmöglich machen würde. Das Wasser wurde über eine Schaumstoffpatrone gefiltert. Gefüttert wurde täglich einmal mit Tabletten Flumon ®. Die Versuche wurden mit jeweils drei verschiedenen

Individuen ein und derselben Spezies durchgeführt. Pro Versuch wurde nur ein Wels im Aquarium gehalten. Die Anpassungszeit betrug 2-3 Tage. Um die Mauthner Reaktion akustisch auszulösen, wurde mit einem Kunststoffhammer an eine Aquarienwand geklopft. Die Versuche wurden sowohl am Tag im Hellen als auch nachts im Dunkeln durchgeführt, wobei sich der Versuchsleiter mit einem Nachtsichtgerät (Biv-Brille, Typ FERO-D 51 ZOB) orientierte. Die Versuchsanlage wurde über Zeitschaltuhren ca. 30 min vor dem jeweiligen Versuch eingeschaltet. Jedes Einzelbild (20 ms Schritte) wurde am Monitor auf eine Folie gezeichnet. Die Folien zeigen übereinandergelegt die Bewegungsphase. Um die Winkelgeschwindigkeit festzustellen, wurde der Winkel von der Mittellinie des Kopfes in 20 ms Schritten gemessen. Die Bewegung der Kopfspitze wurde auf Transparentpapier übertragen; so ließ sich die Translationsgeschwindigkeit errechnen. Sie wird in Körperlängen/s angegeben. Beide Kameras wurden an einem Gestell über dem Aquarium montiert. Der Objektivabstand von der Wasseroberfläche betrug 140 cm. Die Leuchtstoffröhren (Tagesbeleuchtung) waren oberhalb des Aquariums installiert, die Lichtquelle für die Nachtaufnahmen unterhalb. Kameras und Timer waren mit dem Recorder und Monitor verbunden (Abb. 1).

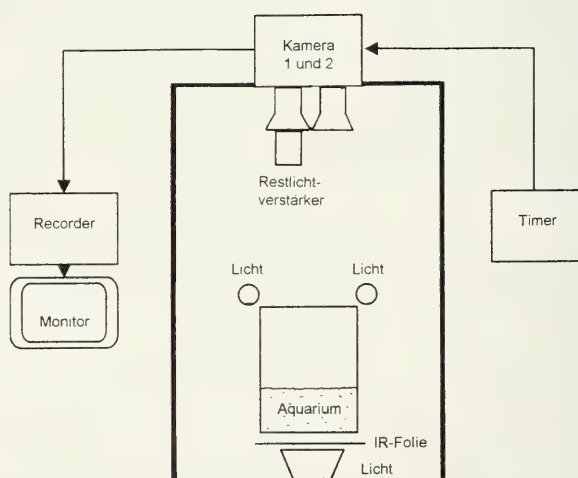


ABB. 1

Versuchsaufbau. Erklärung im Text.

ERGEBNISSE

Von den 51 hier untersuchten Arten (Abb. 2, 3) fehlen Mauthner Axone nur *Carapus acus*, *Gymnotus carapo*, *Dysichthys coracoideus* und *Bunocephalichthys verrucosus*. Innerhalb der Elasmobranchii wurden Mauthner Axone nur bei Embryonen der Squalidae gefunden (Tabelle 1). Innerhalb der Osteichthyes fehlen sie

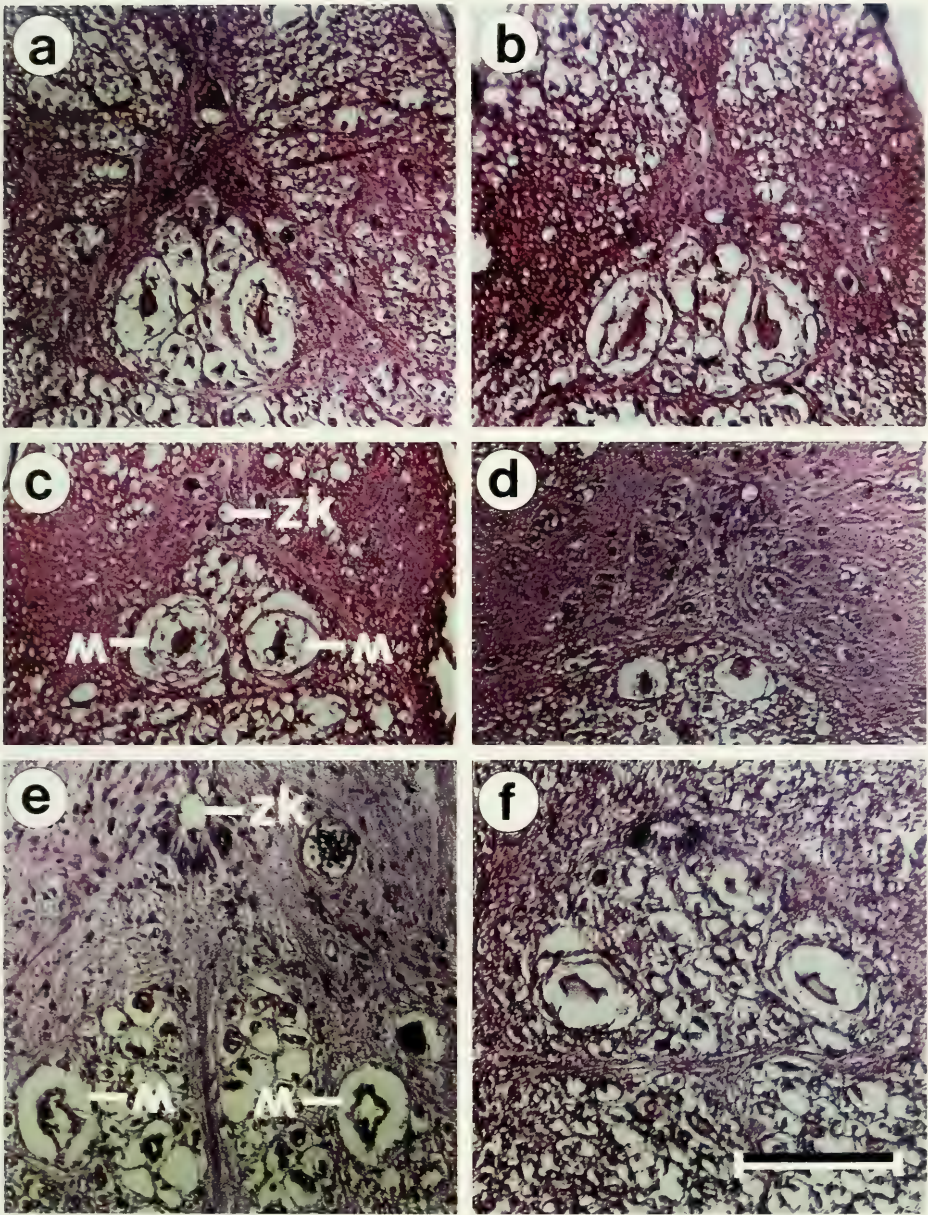


ABB. 2

Rückenmarksquerschnitte mit Mauthner Axonen von Ostariophysi: (a) *Chanos chanos*, (b) *Nematobrycon palmeri*, (c) *Physallia pellucida*, (d) *Ancistrus dolichopterus*, (e) *Arius seemani*, (f) *Apterionotus bonaparti*. M = Mauthner Axon. ZK = Zentralkanal Strichlänge 100 μ m.

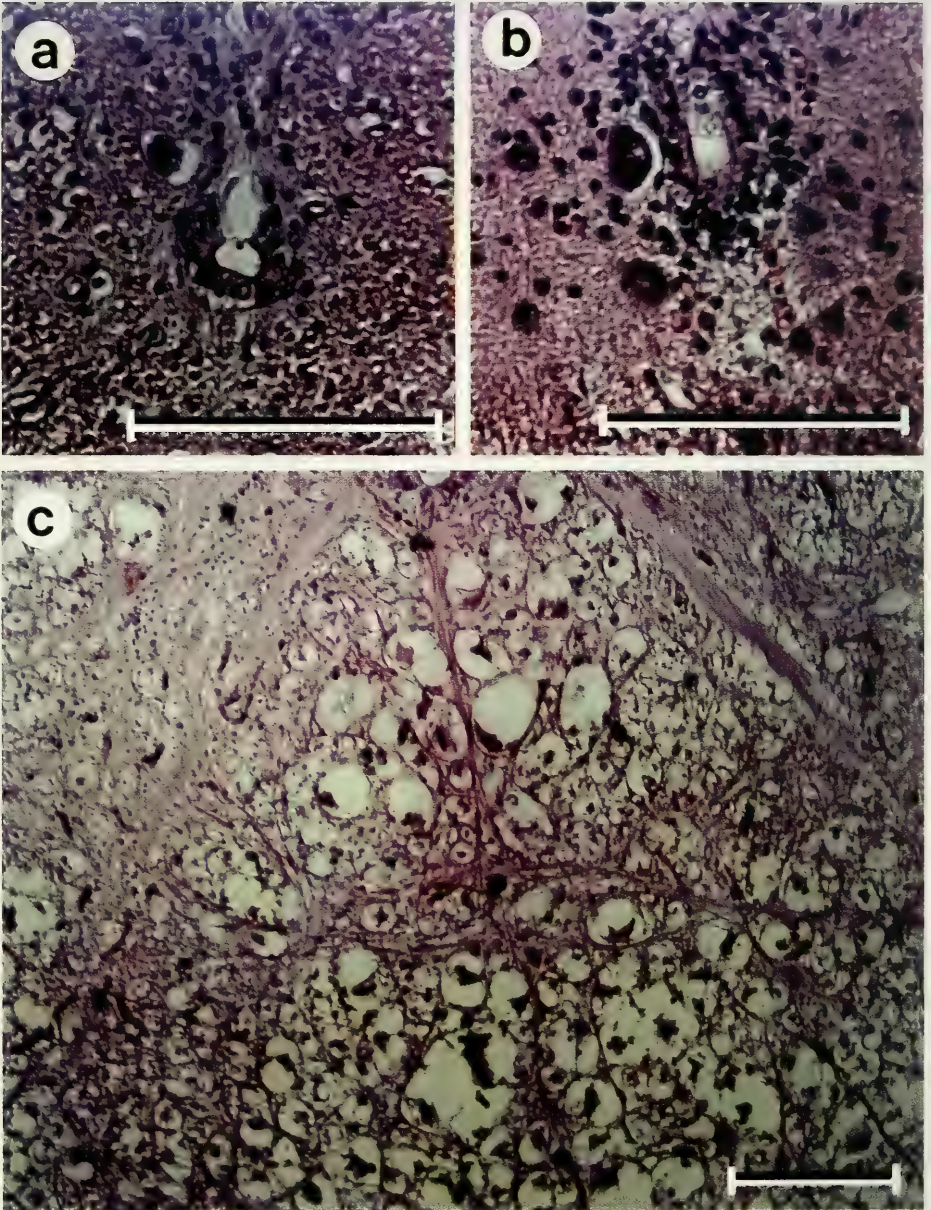


ABB. 3

Rückenmarksquerschnitte ohne Mauthner Axone von Ostariophysi: (a) *Dysichthys coracoideus*, (b) *Bunocephalichthys verrucosus*, (c) *Gymnotus carapo*. Strichlänge 100 μm .

TABELLE 1.

Fische - und Amphibien mit Mauthnerzellen (Spezies ohne Literaturangabe wurden von uns untersucht)

Ordnung	Art	Literatur
Familie		
Petromyzoniformes		
Petromyzonidae	<i>Petromyzones</i>	ZOTTOLI (1978b)
	<i>Petromyzon fluviatilis</i>	STEFANELLI (1932, 1933), WHITING (1957)
	<i>Petromyzon marinus</i>	CURRIE & CARLSEN (1987a,b), ROVAINEN (1974), STEFANELLI (1932, 1933)
	<i>Petromyzon planeri</i>	STEFANELLI (1932, 1933, 1951)
Squaliformes		
Squalidae	dogfish sharks	ZOTTOLI (1978b)
(nur Embryonen)	<i>Scymnorhinus licha</i>	BONE (1977), BONE & MARSHALL (1983)
	<i>Squalus acanthias</i>	BONE (1977), BONE & MARSHALL (1983)
Chimaeriformes		
Chimaeridae	<i>Chimaera</i>	ZOTTOLI (1978b)
	<i>Chimaera</i> (juvenil)	BONE & MARSHALL (1983)
	<i>Hydrolagus</i>	BONE & MARSHALL (1983)
Coelacanthiformes		
Coelacanthidae	<i>Latimeria chalumnae</i>	ZOTTOLI (1978b)
Ceratodiformes		
Ceratodidae	<i>Neoceratodus</i>	ZOTTOLI (1978b)
Lepidosireniformes		
Lepidosirenidae	<i>Lepidosiren</i>	ZOTTOLI (1978b)
Protopteridae	<i>Protopterus annectens</i>	BECCARI (1907), WILSON (1959), ZOTTOLI (1978b)
Acipenseriformes		
Acipenseridae	<i>Acipenser ruthenus</i>	BECCARI (1907), OTSUKA (1964a)
	<i>Acipenser</i>	ZOTTOLI (1978b)
	paddlefishes, Löffelstöre	Zottoli (1978b)
Polypteriformes		
Polypteridae	<i>Calamoichthys calabaricus</i>	
	<i>Polypterus</i>	ZOTTOLI (1978b)
	<i>Polypterus annectens</i>	BECCARI (1907)
Lepisosteiformes		
Lepisosteidae	<i>Lepisosteus</i>	ZOTTOLI (1978b)
Amiiformes		
Amiidae	<i>Amia calva</i>	ZOTTOLI (1978b)
Osteoglossiformes		
Notopteridae	featherbacks, Messerfische	ZOTTOLI (1978b)
Mormyridae	mormyrids, Nilhechte	ZOTTOLI (1978b)
	<i>Gnathonemus petersii</i>	
Notacanthiformes		
Halosauridae	<i>Aldrovandia</i>	BONE & MARSHALL (1983)
	<i>Halosauropsis</i>	BONE & MARSHALL (1983)
	<i>Halosaurus</i>	BONE & MARSHALL (1983)
	<i>Polyacanthonotus</i>	BONE & MARSHALL (1983)
Clupeiformes		
Clupeidae	<i>Clupea</i>	BONE & MARSHALL (1983)
	<i>Clupea harengus</i>	OTSUKA (1964a)
	<i>Clupea pallasii</i>	UCHIHASHI <i>et al.</i> (1960)
	<i>Etrumeus micropus</i>	UCHIHASHI <i>et al.</i> (1960)

	<i>Harengula zunasi</i>	UCHIHASHI <i>et al.</i> (1960)
	herrings, Heringe	ZOTTOLI (1978b)
	<i>Konosirus punctatus</i>	UCHIHASHI <i>et al.</i> (1960)
	<i>Sardinops melanosticta</i>	UCHIHASHI <i>et al.</i> (1960)
Engraulidae	anchovis, Sardellen	ZOTTOLI (1978b)
	<i>Engraulis japonica</i>	UCHIHASHI <i>et al.</i> (1960)
Gonorynchiformes		
Chanidae	<i>Chanos chanos</i>	
Kneriidae	<i>Kneria maydelli</i>	
Phractolaemidae	<i>Phractolaemus ansorgei</i>	
Cypriniformes		
Cyprinidae	<i>Acheilognathus lanceolata</i>	UCHIHASHI <i>et al.</i> (1960)
	<i>Abramis brama</i>	MAYSER (1881)
	<i>Barbus fluviatilis</i>	MAYSER (1881)
	<i>Brachydanio albolineatus</i>	KIMMEL (1972)
	<i>Brachydanio rerio</i>	ALFEI <i>et al.</i> (1991, 1992), BAFFONI & SERRA (1952), EATON <i>et al.</i> (1977a,b, 1984), EATON & FARLEY (1973, 1974), EATON & KIMMEL (1980), EATON & NISSANOV (1985), KIMMEL <i>et al.</i> (1974, 1980, 1981, 1982), PRUGH <i>et al.</i> (1982)
	<i>Carassius auratus</i>	BODIAN (1937), CELIO (1976), DIAMOND (1971), EATON <i>et al.</i> (1977a), EDSTRÖM (1964), FABER & KORN (1975), FUKAMI <i>et al.</i> (1965), FURSHPAN & FURUKAWA (1962), FURUKAWA <i>et al.</i> (1963), KOHNO (1970), OTSUKA (1962, 1964a), ROBERTSON <i>et al.</i> (1963), TRILLER & KORN (1982), UCHHASHI <i>et al.</i> (1960), YASARGIL & DIAMOND (1968), ZOTTOLI (1977)
	carps, minnows, Weißfische	ZOTTOLI (1978b)
	<i>Cyprinus carpio</i>	BECCARI (1907), OTSUKA (1962, 1964a), SCHWARTZ (1975), UCHHASHI <i>et al.</i> (1960)
	<i>Danio malabaricus</i>	BELSARE (1975)
	<i>Gobio fluviatilis</i>	MAYSER (1881)
	<i>Labeo rohita</i>	BELSARE (1975)
	<i>Leuciscus cephalus</i>	MAYSER (1881)
	<i>Luciosoma spilopleura</i>	
	<i>Notemigonus crysoleucas</i>	ZOTTOLI (1978b)
	<i>Phoxinus phoxinus</i>	OTSUKA (1964a)
	<i>Rutilus rutilus</i>	OTSUKA (1964a)
	<i>Tinca tinca</i>	BAUMANN & YASARGIL (1981), CELIO (1976), OTSUKA (1964a), TRILLER & KORN (1980, 1982), YASARGIL <i>et al.</i> (1982, 1986), YASARGIL & SANDRI (1987)
	<i>Tribolodon hakonensis</i>	UCHHASHI <i>et al.</i> (1960)
Catostomidae	<i>Catostomus commersoni</i>	ZOTTOLI (1978b)
	suckers, Sauger	ZOTTOLI (1978b)
Cobitidae	<i>Acanthopthalmus kuhlii</i>	
	<i>Cobitis fossilis</i>	MAYSER (1881)
	loaches, Schmerlen	ZOTTOLI (1978b)
	<i>Misgurnus anguillicaudatus</i>	OTSUKA (1962, 1964a)
Gyrinocheilidae	<i>Gyrinocheilus aymonieri</i>	
Homalopteridae	<i>Homalopterus</i>	
	<i>Sinohomaloptera</i>	

Characiformes		
Characidae	<i>Aoptichthys jordani</i>	OTSUKA (1964a)
	<i>Astyanax bimaculatus</i>	
	<i>Astyanax mexicanus</i>	OTSUKA (1964a)
	characins, Salmier	ZOTTOLI (1978b)
	<i>Hydrocynus maculatus</i>	EATON <i>et al.</i> (1977a)
	<i>Hyphessobrycon flammeus</i>	OTSUKA (1964a)
	<i>Micralestes interruptus</i>	
	<i>Nematobrycon palmeri</i>	
	<i>Pristella maxillaris</i>	
	<i>Stevardia riisei</i>	SCHWARTZ (1975)
Lebiasinidae	<i>Nannostomus beckfordi</i>	
	<i>Poecilibrycon ocellatus</i>	
Gasteropelecidae	<i>Carnegiella strigata</i>	EATON <i>et al.</i> (1977a)
	<i>Gasteropelecus sternicla</i>	AUERBACH & BENETT (1969), EATON <i>et al.</i> (1977a)
	<i>Gasteropelecus</i>	HUSE <i>et al.</i> (1985)
	hatchetfishes, Beilbauchfische	ZOTTOLI (1978b)
Hemiodontidae	<i>Hemiodus semitaeniatus</i>	
Anostomidae	<i>Anostomus anostomus</i>	
	<i>Leporinus affinis</i>	
Citharinidae	<i>Phago maculatus</i>	
Ctenoluciidae	<i>Boulengerella lucia</i>	
Crenuchidae	<i>Crenuchus spilurus</i>	
Siluriformes		
Siluridae	eurasian catfishes, Welse	ZOTTOLI (1978b)
	<i>Kryptopterus bicirrhus</i>	
	<i>Parasilurus asotus</i>	OTSUKA (1962, 1964a), UCHIHASHI <i>et al.</i> (1960)
Schilbeidae	<i>Pangasius sutchi</i>	
	<i>Physalia pellucida</i>	
Ictaluridae	freshwater catfishes,	
	Katzenwelse	ZOTTOLI (1978b)
	<i>Ictalurus melas</i>	BODIAN (1937)
	<i>Ictalurus nebulosus</i>	EATON <i>et al.</i> (1977a), OTSUKA (1964b), ZOTTOLI (1978a)
Bagridae	<i>Chrysichthys</i>	OTSUKA (1964a)
	bagrid catfish, Stachelwels	ZOTTOLI (1978b)
	<i>Mystus gulio</i>	
Clariidae	<i>Clarias batrachus</i>	BELSARE (1975)
	<i>Heteropneustes fossilis</i>	BELSARE (1975)
	labyrinthic catfish, Raubwels	ZOTTOLI (1978b)
Malapteruridae	electric catfishes, Zitterwelse	ZOTTOLI (1978b)
Mochokidae	<i>Synodontis nigriventris</i>	
Ariidae	<i>Arius seemani</i>	
Plotosidae	<i>Plotosus lineatus</i>	
Callichthyidae	callichthyid armoured catfishes, Panzerwelse	ZOTTOLI (1978b)
	<i>Corydoras arcuatus</i>	
	<i>Dianema urostriata</i>	
	<i>Ancistrus dolichopterus</i>	
Loricariidae		
Gymnotiformes		
Gymnotidae	<i>Gymnotus carapo</i>	TRUJILLO-CENOS & BERTOLOTTI (1989)
Apteronotidae	<i>Apteronotus albifrons</i>	EATON <i>et al.</i> (1977a)
	<i>Apteronotus bonaparti</i>	

	blackghosts, Messeraale	ZOTTOLI (1978b)
Salmoniformes		
Salmonidae	trouts, salmons, graylings, Forellen, Lachse, Äschen <i>Oncorhynchus gorbusha</i> <i>Oncorhynchus keta</i> <i>Oncorhynchus kisutch</i> <i>Oncorhynchus masou</i> <i>Oncorhynchus mykiss</i> (Syn. <i>Salmo gaidneri</i>)	ZOTTOLI (1978b) UCHIHASHI <i>et al.</i> (1960) UCHIHASHI <i>et al.</i> (1960) UCHIHASHI <i>et al.</i> (1960) UCHIHASHI <i>et al.</i> (1960) EATON <i>et al.</i> (1977a), LEGHISSA (1942), OTSUKA (1962, 1964a), PFISTER <i>et al.</i> (1973), PFISTER & DANNER (1973), SCHWARTZ (1971, 1974, 1975), STEFANELLI (1951), UCHIHASHI <i>et al.</i> (1960) UCHIHASHI <i>et al.</i> (1960) OTSUKA (1964a) UCHIHASHI <i>et al.</i> (1960) BONE & MARSHALL (1983) STEFANELLI (1951) ZOTTOLI (1978a) MAYSER (1881) STEFANELLI (1951), ZOTTOLI (1978a) UCHIHASHI <i>et al.</i> (1960), ZOTTOLI (1978a) UCHIHASHI <i>et al.</i> (1960) UCHIHASHI <i>et al.</i> (1960)
	<i>Oncorhynchus nerka</i> <i>Oncorhynchus rhodurus</i> <i>Oncorhynchus tshawytscha</i> <i>Salmo</i> <i>Salmo lacustris</i> <i>Salmo salar</i> <i>Salmo salvelinus</i> <i>Salmo trutta</i> <i>Salvelinus fontinalis</i> <i>Salvelinus malma</i> <i>Salvelinus pluvius</i>	UCHIHASHI <i>et al.</i> (1960) OTSUKA (1964a) UCHIHASHI <i>et al.</i> (1960) BONE & MARSHALL (1983) STEFANELLI (1951) ZOTTOLI (1978a) MAYSER (1881) STEFANELLI (1951), ZOTTOLI (1978a) UCHIHASHI <i>et al.</i> (1960), ZOTTOLI (1978a) UCHIHASHI <i>et al.</i> (1960) UCHIHASHI <i>et al.</i> (1960)
Plecoglossidae	ayofish, Ayos <i>Plecoglossus altivelis</i>	ZOTTOLI (1978b) OTSUKA (1962, 64a)
Osmeridae	<i>Hypomesus olidus</i> <i>Osmerus mordax</i> smelts, Stinte	UCHIHASHI <i>et al.</i> (1960) ZOTTOLI (1978a) ZOTTOLI (1978a)
Retropinnidae	<i>Retropinna retropinna</i>	
Galaxiidae	<i>Galaxias</i> <i>Galaxias attenuatus</i> <i>Galaxias brevipinnis</i> <i>Galaxias fasciatus</i> <i>Galaxias maculatus</i> <i>Neochanna apoda</i>	BONE & MARSHALL (1983)
Aplocheilichthyidae	<i>Aplocheilichthys zebra</i>	
Esocidae	<i>Esox lucius</i>	BECCARI (1907), MAUTHNER (1859), MAYSER (1881), OTSUKA (1964a) ZOTTOLI (1978b)
Argentinidae	pikes, Hechte argentines, Goldlachse <i>Argentina semifasciata</i> <i>Argentina silus</i> <i>Argentina sphyraena</i>	ZOTTOLI (1978b) UCHIHASHI <i>et al.</i> (1960) OTSUKA (1964a) OTSUKA (1964a)
Bathylagidae	<i>Bathylagus</i> <i>Nansenia</i> <i>Opisthoproctus</i>	BONE & MARSHALL (1983) BONE & MARSHALL (1983) BONE & MARSHALL (1983)
Alepocephalidae	<i>Alepocephalus</i> <i>Leptoderma</i> <i>Talismania</i> <i>Xenodermichthys</i>	BONE & MARSHALL (1983) BONE & MARSHALL (1983) BONE & MARSHALL (1983) BONE & MARSHALL (1983)
Searsiidae	<i>Searsia</i>	BONE & MARSHALL (1983)
Astronesthidae	<i>Astronesthes</i> <i>Radonesthes</i>	BONE & MARSHALL (1983) BONE & MARSHALL (1983)

Stomiatiiformes		
Gonostomatidae	<i>Bonapartia</i>	BONE & MARSHALL (1983)
	<i>Cyclothone braueri</i>	BONE & MARSHALL (1983)
	<i>Cyclothone microdon</i>	BONE & MARSHALL (1983)
	<i>Cyclothone obscura</i>	BONE & MARSHALL (1983)
	<i>Cyclothone pygmaea</i>	BONE & MARSHALL (1983)
	deepsea bristlemouths,	
	Borstenmünder	ZOTTOLI (1978b)
	<i>Diplophos</i>	BONE & MARSHALL (1983)
	<i>Gonostoma atlanticum</i>	BONE & MARSHALL (1983)
	<i>Gonostoma bathyphilum</i>	BONE & MARSHALL (1983)
	<i>Gonostoma denudatum</i>	BONE & MARSHALL (1983)
	<i>Gonostoma elongatum</i>	BONE & MARSHALL (1983)
	<i>Maurolicus</i>	BONE & MARSHALL (1983)
	<i>Maurolicus japonicus</i>	UCHIHASHI <i>et al.</i> (1960)
	<i>Valencienellus</i>	BONE & MARSHALL (1983)
	<i>Vinciguerra</i>	BONE & MARSHALL (1983)
Sternoptychidae	<i>Argyropelecus</i>	BONE & MARSHALL (1983)
	deepsea hatchetfishes,	
	Tiefsee-Beilfische	ZOTTOLI (1978b)
Chauliodontidae	<i>Sternoptychus</i>	BONE & MARSHALL (1983)
	<i>Chauliodus</i>	BONE & MARSHALL (1983)
	<i>Chauliodus sloani</i>	
Stomiidae	<i>Stomias</i>	BONE & MARSHALL (1983)
Melanostomiidae	<i>Bathophilus</i>	BONE & MARSHALL (1983)
	<i>Eustomias</i>	BONE & MARSHALL (1983)
	<i>Pachystomias</i>	BONE & MARSHALL (1983)
Malacosteidae	<i>Malacosteus</i>	BONE & MARSHALL (1983)
	<i>Photostomias</i>	BONE & MARSHALL (1983)
Idiacanthidae	<i>Idiacanthus</i>	BONE & MARSHALL (1983)
Aulopiformes		
Bathypteroidae	<i>Bathypterois</i>	BONE & MARSHALL (1983)
Scopelarchidae	<i>Benthalbella</i>	BONE & MARSHALL (1983)
	<i>Scopelarchus</i>	BONE & MARSHALL (1983)
Scopelosauridae	<i>Scopelosaurus</i>	BONE & MARSHALL (1983)
Synodidae	lizardfishes, Eidechsenfische	ZOTTOLI (1978b)
	<i>Saurida undosquamis</i>	UCHIHASHI <i>et al.</i> (1960)
Giganturidae	<i>Gigantura</i>	BONE & MARSHALL (1983)
Paralepididae	<i>Paralepis</i>	BONE & MARSHALL (1983)
Omosudidae	<i>Omosudis</i>	BONE & MARSHALL (1983)
Evermannellidae	<i>Coccorella</i>	BONE & MARSHALL (1983)
Myctophiformes		
Myctophidae	<i>Ceratoscopelus</i>	BONE & MARSHALL (1983)
	<i>Diaphus</i>	BONE & MARSHALL (1983)
	<i>Electrona</i>	BONE & MARSHALL (1983)
	<i>Lampanyctus</i>	BONE & MARSHALL (1983)
	<i>Myctophum</i>	BONE & MARSHALL (1983)
	<i>Notoscopelus</i>	BONE & MARSHALL (1983)
Amblyopsiformes		
Amblyopsidae	cavefishes, Blindfische	ZOTTOLI (1978b)
Gadiformes		
Merlucciidae	<i>Merluccius merluccius</i>	OTSUKA (1964a)
	hakes, Seehechte	ZOTTOLI (1978b)
Gadidae	<i>Brosme brosme</i>	OTSUKA (1964a)
	codfishes, Dorsche	ZOTTOLI (1978b)

	<i>Enchelyopus cimbrius</i>	OTSUKA (1964a)
	<i>Gadus</i>	BONE & MARSHALL (1983)
	<i>Gadus macrocephalus</i>	UCHIHASHI <i>et al.</i> (1960)
	<i>Gadus morrhua</i>	OTSUKA (1964a), ZOTTOLI (1978a)
	<i>Melanogrammus aeglefinus</i>	MAYSER (1881), OTSUKA (1964a)
	<i>Merlangius merlangus</i>	OTSUKA (1964a)
	<i>Microgadus tomcod</i>	ZOTTOLI (1978a)
	<i>Micromesistius poutassou</i>	OTSUKA (1964a)
	<i>Molva</i>	BONE & MARSHALL (1983)
	<i>Molva dipterygia</i>	OTSUKA (1964a)
	<i>Molva molva</i>	OTSUKA (1964a)
	<i>Pollachius virens</i>	OTSUKA (1964a)
	<i>Raniceps raninus</i>	OTSUKA (1964a)
	<i>Theragra chalcogramma</i>	UCHIHASHI <i>et al.</i> (1960)
	<i>Urophycis blennioides</i>	OTSUKA (1964a)
	<i>Urophycis chuss</i>	ZOTTOLI (1978a)
	<i>Urophycis tenuis</i>	ZOTTOLI (1978a)
Macrouridae	<i>Chalinura</i>	BONE & MARSHALL (1983)
	<i>Coelorhynchus coelorhynchus</i>	OTSUKA (1964a)
	<i>Coryphaenoides rupestris</i>	OTSUKA (1964a)
	grenadiers, Grenadierfische	ZOTTOLI (1978b)
	<i>Nezumia</i>	BONE & MARSHALL (1983)
	<i>Spagemacrus</i>	BONE & MARSHALL (1983)
	<i>Trachyrhynchus</i>	BONE & MARSHALL (1983)
Ophidiidae	<i>Monomitopus</i>	BONE & MARSHALL (1983)
Zoarcidae	eelpouts, Aalquappen	ZOTTOLI (1978b)
	<i>Melanostigma</i>	BONE & MARSHALL (1983)
	<i>Zoarces viviparus</i>	OTSUKA (1964a)
Melanonidae	<i>Melanonus</i>	BONE & MARSHALL (1983)
Atheriniformes		
Hemiramphidae	<i>Hemiramphus sajori</i>	UCHIHASHI <i>et al.</i> (1960)
Exocoetidae	flying fishes, halfbeaks, Fliegende Fische, Halbschnäbler	ZOTTOLI (1978b)
	<i>Prognichthys agoo</i>	UCHIHASHI <i>et al.</i> (1960)
Belonidae	<i>Belone belone</i>	OTSUKA (1964a)
	needlefishes, Hornhechte	ZOTTOLI (1978b)
	<i>Xenodon cancila</i>	EATON <i>et al.</i> (1977a)
Scomberesocidae	<i>Cololabis saira</i>	UCHIHASHI <i>et al.</i> (1960)
	sauriers, Makrelenhechte	ZOTTOLI (1978b)
Atherinidae	silversides, Ährenfische	ZOTTOLI (1978b)
Oryziatidae	<i>Oryzias latipes</i>	OTSUKA (1962)
Goodeidae	<i>Ameca splendens</i>	
Cyprinodontiformes		
Cyprinodontidae	<i>Fundulus</i> (Embryo)	STEFANELLI (1951)
	killifishes, Zahnkärpflinge	ZOTTOLI (1978b)
	<i>Limia dominicensis</i>	OTSUKA (1964a)
	<i>Phallichthys amates</i>	OTSUKA (1964a)
Poeciliidae	<i>Gambusia patruelis</i>	OTSUKA (1964a)
	<i>Poecilia reticulata</i> (syn. <i>Lebistes reticulatus</i>)	ALFEI <i>et al.</i> (1991, 1992), JAKOUBEK <i>et al.</i> (1970), LEGHISSA (1978), OTSUKA (1962, 1964a)
	<i>Poecilia sphenops</i>	SCHWARTZ (1975)
	<i>Xiphophorus helleri</i>	OTSUKA (1964a)
	<i>Xiphophorus maculatus</i>	OTSUKA (1964a)

	<i>Xiphophorus montezumae</i>	OTSUKA (1964a)
	<i>Xiphophorus xiphidium</i>	OTSUKA (1964a)
Beryciformes		
Melamphaeidae	<i>Melamphaes</i>	BONE & MARSHALL (1983)
Anoplogasteridae	<i>Anoplogaster</i>	BONE & MARSHALL (1983)
Zeiformes		
Zeidae	dories, Petersfische	ZOTTOLI (1978b)
	<i>Zeus japonicus</i>	UCHIHASHI <i>et al.</i> (1960)
Caproidae	boarfishes, Eberfische	ZOTTOLI (1978b)
Gasterosteiformes		
Gasterosteidae	<i>Gasterosteus aculeatus</i>	OTSUKA (1964a)
	sticklebacks, Stichlinge	ZOTTOLI (1978b)
Centriscidae	<i>Aeoliscus strigatus</i>	
	shrimpfishes,	
	Schnepfenmesserfische	ZOTTOLI (1978b)
Synbranchiformes		
Synbranchidae	cuchia, Sumpfaale	ZOTTOLI (1978b)
Channiformes		
Channidae	<i>Channa argus</i>	OTSUKA (1962, 1964a), UCHHASHI <i>et al.</i> (1960)
	snakeheads,	
	Schlangenkopffische	ZOTTOLI (1978b)
Scorpaeniformes		
Scorpaenidae	scorpionfishes, Drachenfische	ZOTTOLI (1978b)
	<i>Scorpaena scrofa</i>	OTSUKA (1964a)
	<i>Sebastes dallii</i>	EATON <i>et al.</i> (1977a)
	<i>Sebastes inermis</i>	UCHIHASHI <i>et al.</i> (1960)
	<i>Sebastes marinus</i>	ZOTTOLI (1978a)
	<i>Sebastes norvegicus</i>	OTSUKA (1964a)
	<i>Sebastiscus marmoratus</i>	UCHIHASHI <i>et al.</i> (1960)
	<i>Sebastolobus macrochir</i>	UCHIHASHI <i>et al.</i> (1960)
Synanceiidae	<i>Inimicus japonicus</i>	UCHIHASHI <i>et al.</i> (1960)
	stonefish, Steinfisch	ZOTTOLI (1978b)
Triglidae	<i>Chelidonichthys kumu</i>	UCHIHASHI <i>et al.</i> (1960)
	<i>Lepidotrigla microptera</i>	UCHIHASHI <i>et al.</i> (1960)
	searobins, Knurrhähne	ZOTTOLI (1978b)
	<i>Trigla</i>	BONE & MARSHALL (1983)
	<i>Trigla gurnardus</i>	OTSUKA (1964a,b)
Platycephalidae	<i>Cociella crocodila</i>	UCHIHASHI <i>et al.</i> (1960)
	river gurnards, Flachköpfe	ZOTTOLI (1978b)
	<i>Platycephalus indicus</i>	UCHIHASHI <i>et al.</i> (1960)
Hexagrammidae	greenlings, Grünlinge	ZOTTOLI (1978b)
	<i>Hexagrammos otakii</i>	UCHIHASHI <i>et al.</i> (1960)
	<i>Pleurogrammus azonus</i>	UCHIHASHI <i>et al.</i> (1960)
Cottidae	<i>Hemirhamphus americanus</i>	ZOTTOLI (1978a)
	<i>Leptocottus armatus</i>	ZOTTOLI (1978a)
	<i>Myoxocephalus aeneus</i>	ZOTTOLI (1978a)
	<i>Myoxocephalus</i>	
	<i>octodecimspinosus</i>	ZOTTOLI (1978a)
	<i>Myoxocephalus scorpius</i>	OTSUKA (1964a)
	<i>Psychrolutes paradoxus</i>	ZOTTOLI (1978a)
	sculpins, Groppen	OTSUKA (1964b), ZOTTOLI (1978b)
Agonidae	poachers, alligatorfishes,	
	Panzergruppen	ZOTTOLI (1978b)
Dactylopteriformes		
Dactylopteridae	<i>Dactylopterus volitans</i>	OTSUKA (1964a)

	flying gurnards, Flughähne	ZOTTOLI (1978b)
Perciformes		
Serranidae	<i>Epinephelus fario</i>	UCHIHASHI <i>et al.</i> (1960)
	<i>Paralabrax clathratus</i>	EATON <i>et al.</i> (1977a)
	sea basses, Seebarsche	ZOTTOLI (1978b)
	<i>Serranus scriba</i>	OTSUKA (1964a)
Moronidae	<i>Coreoperca kawamebari</i>	UCHIHASHI <i>et al.</i> (1960)
	<i>Doederleinia berycoides</i>	UCHIHASHI <i>et al.</i> (1960)
	<i>Lateolabrax japonicus</i>	UCHIHASHI <i>et al.</i> (1960)
Priacanthidae	bigeyes, Großaugen	ZOTTOLI (1978b)
	<i>Priacanthus macracanthus</i>	UCHIHASHI <i>et al.</i> (1960)
Apogonidae	cardinal fishes, Kardinalfische	ZOTTOLI (1978b)
Centrarchidae	<i>Ambloplites rupestris</i>	ZOTTOLI (1978a)
	<i>Lepomis gibbosus</i>	ZOTTOLI (1978a)
	<i>Micropterus salmoides</i>	ZOTTOLI (1978a)
	sunfishes, Sonnenbarsche	ZOTTOLI (1978b)
Percidae	<i>Lucioperca lucioperca</i>	SCHWARTZ (1975)
	<i>Lucioperca sandra</i>	MAYSER (1881)
	perches, walleyes, darters, Barsche	ZOTTOLI (1978b)
Sillaginidae	<i>Sillago sihama</i>	UCHIHASHI <i>et al.</i> (1960)
	smelt whittings, Weißlinge	ZOTTOLI (1978b)
Lutjanidae	snappers, Schnapper	ZOTTOLI (1978b)
Pomadasyidae	grunts, Grunzer	ZOTTOLI (1978b)
Sparidae	<i>Chrysophrys major</i>	UCHIHASHI <i>et al.</i> (1960)
	<i>Diplodus annularis</i>	OTSUKA (1964a)
	<i>Diplodus sargus</i>	OTSUKA (1964a)
	<i>Mylio macrocephalus</i>	UCHIHASHI <i>et al.</i> (1960)
	porgies, Meerbrassen	ZOTTOLI (1978b)
Emmelichthyidae	bonnetmouths	ZOTTOLI (1978b)
Mullidae	goatfishes, Seebaren	ZOTTOLI (1978b)
	<i>Mullus barbatus</i>	OTSUKA (1964a)
	<i>Upeneus bensasi</i>	UCHIHASHI <i>et al.</i> (1960)
Sciaenidae	<i>Argyrosomus argentatus</i>	UCHIHASHI <i>et al.</i> (1960)
	drums, Trommler	ZOTTOLI (1978b)
Pomatomidae	bluefishes, Blaufische	ZOTTOLI (1978b)
Echeneidae	remoras, Schiffshalter	ZOTTOLI (1978b)
Carangidae	jacks, scads, pompanos, Stachelmakrelen	ZOTTOLI (1978b)
	<i>Trachurus</i>	BONE & MARSHALL (1983)
	<i>Trachurus japonicus</i>	UCHIHASHI <i>et al.</i> (1960)
	<i>Trachurus trachurus</i>	OTSUKA (1964a)
Coryphaenidae	<i>Coryphaena hippurus</i>	UCHIHASHI <i>et al.</i> (1960)
	dolphins, Goldmakrelen	ZOTTOLI (1978b)
Kyphosidae	seachubs, Pilotbarsche	ZOTTOLI (1978b)
Chaetodontidae	butterflyfishes, Falterfische	ZOTTOLI (1978b)
	<i>Chaetodon mesoleucus</i>	OTSUKA (1964a)
	<i>Chaetodon trifasciatus</i>	OTSUKA (1964a)
Nandidae	leaffishes, Nanderbarsche	ZOTTOLI (1978b)
	<i>Nandus nandus</i>	BELSARE (1975)
Cepolidae	bandfishes, Bandfische	ZOTTOLI (1978b)
Mugilidae	<i>Mugil cephalus</i>	UCHIHASHI <i>et al.</i> (1960)
	mulletts, Meeräschen	ZOTTOLI (1978b)
Sphyraenidae	barracuda, Barrakuda	ZOTTOLI (1978b)
	<i>Sphyraena pinguis</i>	UCHIHASHI <i>et al.</i> (1960)

Pomacentridae	<i>Chromis chromis</i> damsel-fishes, Riffbarsche	OTSUKA (1964a) ZOTTOLI (1978b)
Embiotocidae	<i>Ditrema temmincki</i> surfperches,	UCHIHASHI <i>et al.</i> (1960)
Labridae	Brandungsbarsche	ZOTTOLI (1978b)
	<i>Coris julis</i>	OTSUKA (1964a)
	<i>Halichoeres poecilopterus</i>	UCHIHASHI <i>et al.</i> (1960)
	<i>Hemigymnus fasciatus</i>	OTSUKA (1964a)
	<i>Labrus viridis</i>	OTSUKA (1964a)
	<i>Symphodus cinereus</i>	OTSUKA (1964a)
	<i>Symphodus mediterraneus</i>	OTSUKA (1964a)
	<i>Symphodus rostratus</i>	OTSUKA (1964a)
	<i>Symphodus tinca</i>	OTSUKA (1964a)
	<i>Thalassoma</i>	OTSUKA (1964a)
Scaridae	wrasses, Lippfische	ZOTTOLI (1978b)
	parrotfishes, Papageifische	ZOTTOLI (1978b)
Cichlidae	cichlids, Buntbarsche	ZOTTOLI (1978b)
	<i>Hemichromis</i>	OTSUKA (1964a)
Trachinidae	<i>Trachinus draco</i>	OTSUKA (1964a)
Trichodontidae	weevers, Petermännchen	ZOTTOLI (1978b)
	sandfishes, Sandfische	ZOTTOLI (1978b)
Uranoscopidae	<i>Gnathagnus elongatus</i>	UCHIHASHI <i>et al.</i> (1960)
Blenniidae	<i>Blennius</i> combtooth blennies,	DE ANGELIS (1950)
	Schleimfische	ZOTTOLI (1978b)
Clinidae	clinids, beschuppte	
	Schleimfische	ZOTTOLI (1978b)
Stichaeidae	<i>Clinus</i>	DE ANGELIS (1950), STEFANELLI (1951)
	<i>Anoplarchus purpureus</i>	ZOTTOLI (1978a)
	picklebacks, Stachelrücken	ZOTTOLI (1978b)
	<i>Stichaeus grigorjewi</i>	UCHIHASHI <i>et al.</i> (1960)
Pholididae	<i>Xiphister mucosus</i>	ZOTTOLI (1978a)
	gunnels, Butterfische	ZOTTOLI (1978b)
Ammodytidae	<i>Ammodytes personatus</i>	UCHIHASHI <i>et al.</i> (1969)
	sandlances, Sandspierlinge	ZOTTOLI (1978b)
Callionymidae	<i>Callionymus lunatus</i>	UCHIHASHI <i>et al.</i> (1960)
	dragonets, Leierfische	ZOTTOLI (1978b)
Gobiidae	<i>Acanthogobius flavimanus</i>	UCHIHASHI <i>et al.</i> (1960)
	<i>Cryptocentrus filifer</i>	UCHIHASHI <i>et al.</i> (1960)
	gobies, Grundeln	ZOTTOLI (1978b)
	<i>Gobius</i>	DE ANGELIS (1950), STEFANELLI (1951)
Periophthalmidae	<i>Periophthalmus</i>	
Eleotridae	<i>Mogurnda obscura</i>	UCHIHASHI <i>et al.</i> (1960)
Gobioididae	eellike gobies, Aalgrundeln	ZOTTOLI (1978b)
Gempylidae	<i>Neolotus</i>	BONE & MARSHALL (1983)
Trichiuridae	<i>Diplospinus</i>	BONE & MARSHALL (1983)
	snakefishes, Haarschwänze	ZOTTOLI (1978b)
	<i>Trichiurus lepturus</i>	UCHIHASHI <i>et al.</i> (1960)
	<i>Euthynnus affinis</i>	UCHIHASHI <i>et al.</i> (1960)
Scombridae	<i>Katsuwonus pelamis</i>	UCHIHASHI <i>et al.</i> (1960)
	mackerels, tunas, Makrelen,	
	Thunfische	ZOTTOLI (1978b)
	<i>Scomber</i>	BONE & MARSHALL (1983)
	<i>Scomber japonicus</i>	UCHIHASHI <i>et al.</i> (1960)
	<i>Scomber scombrus</i>	OTSUKA (1964a)

	<i>Scomberomorus niphonius</i>	UCHIHASHI <i>et al.</i> (1960)
	<i>Thunnus thynnus</i>	UCHIHASHI <i>et al.</i> (1960)
Stromateidae	butterfishes, Medusenfische	ZOTTOLI (1978b)
Anabantidae	climbing perces, Kletterfische	ZOTTOLI (1978b)
Belontiidae	<i>Betta splendens</i> siamese fighting fish, Kampffisch	UCHIHASHI <i>et al.</i> (1960) ZOTTOLI (1978b)
Mastacembelidae	mastacembelid eels, Stachelaale	ZOTTOLI (1978b)
	<i>Mastacembelus loennbergi</i>	EATON <i>et al.</i> (1977a)
Oplegnathidae	knifejaws, Messerkiefer	ZOTTOLI (1978b)
Pleuronectiformes		
Scophthalmidae	<i>Lepidorhombus whiffiagonis</i>	OTSUKA (1964a,b)
	<i>Psetta maxima</i>	OTSUKA (1964a,b)
Bothidae	lefteye flounders, Linksaugenflundern	ZOTTOLI (1978b)
	<i>Paralichthys californicus</i>	EATON <i>et al.</i> (1977a)
	<i>Paralichthys dentatus</i>	ZOTTOLI (1978a)
	<i>Paralichthys olivaceus</i>	UCHIHASHI <i>et al.</i> (1960)
	<i>Tanakius kitaharai</i>	UCHIHASHI <i>et al.</i> (1960)
Pleuronectidae	<i>Citharichthys sordidus</i>	ZOTTOLI (1978a)
	<i>Glyptocephalus cynoglossus</i>	ZOTTOLI (1978a)
	<i>Glyptocephalus stelleri</i>	UCHIHASHI <i>et al.</i> (1960)
	<i>Hippoglossoides dubius</i>	UCHIHASHI <i>et al.</i> (1960)
	<i>Hippoglossoides elassodon</i>	ZOTTOLI (1978a)
	<i>Hippoglossoides platessoides</i>	OTSUKA (1964a), ZOTTOLI (1978a)
	<i>Hippoglossus stenolepis</i>	UCHIHASHI <i>et al.</i> (1960)
	<i>Limanda ferruginea</i>	ZOTTOLI (1978a)
	<i>Limanda Herzensteini</i>	UCHIHASHI <i>et al.</i> (1960)
	<i>Platichthys flesus</i>	OTSUKA (1964a)
	<i>Platichthys stellatus</i>	ZOTTOLI (1978a)
	<i>Pleuronectes platessa</i>	OTSUKA (1964a), ZOTTOLI (1978a)
	<i>Pseudopleuronectes</i>	
	<i>americanus</i>	ZOTTOLI (1978a, 1981)
	righteye flounder, Scholle	ZOTTOLI (1978b)
	<i>Scophthalmus aquosus</i>	ZOTTOLI (1978a)
Soleidae	<i>Solea</i>	DE ANGELIS (1950), STEFANELLI (1951)
	soles, Seezungen	ZOTTOLI (1978b)
Tetraodontiformes		
Triacanthodidae	<i>Navodon modestus</i>	UCHIHASHI <i>et al.</i> (1960)
Balistidae	<i>Stephanolepis cirrifer</i>	UCHIHASHI <i>et al.</i> (1960)
	triggerfishes, Drückerrfische	ZOTTOLI (1978b)
Tetraodontidae	<i>Colomesus psittacus</i>	
	<i>Tetraodon fluviatilis</i>	
	<i>Tetraodon steindachneri</i>	
Amphibia		
Urodela		
	Cryptobranchidae <i>Cryptobranchus japonicum</i>	KINGSBURY (1895), STEFANELLI (1951), TUERKHEIM (1903)
	giant salamanders, Riesensalamander	ZOTTOLI (1978b)
Ambystomatidae	<i>Ambystoma</i>	DETWILER (1927), HERRICK (1914), HOLTFRETER (1931)
	<i>Ambystoma maculatum</i>	PIATT (1969)

	<i>Ambystoma mexicanum</i>	LEGISSHA (1941)
	<i>Ambystoma punctatum</i>	HIBBARD (1965), SZEPESENWOL (1936)
	mole salamanders,	
	Querzahnmolche	ZOTTOLI (1978b)
Salamandridae	newts, Molche	ZOTTOLI (1978b)
	<i>Pleurodeles waltli</i>	HIBBARD (1965)
	<i>Triturus cristatus</i>	BURCKHARDT (1889), STEFANELLI (1951)
Proteidae	mudpuppies, olm,	
	Furchenmolche, Grottenolm	ZOTTOLI (1978b)
	<i>Proteus</i>	STEFANELLI (1951)
Plethodontidae	lungless salamanders,	
	Lungenlose Molche und	
	Salamander	ZOTTOLI (1978b)
	<i>Hydromantes genei</i>	SZEPESENWOL (1935)
Sirenidae	sirens, Armmolche	ZOTTOLI (1978b)
Gymnophiona		
Ichthyophiidae		
(nur Larven)	caecilians, Blindwühlen	ZOTTOLI (1978b)
Anura		
(nur Kaulquappen)		
Discoglossidae	<i>Bombina variegata</i>	LARSELL (1934)
	firebellies, midwives,	
	Unken, Geburtshelferkröten	ZOTTOLI (1978b)
	<i>Discoglossus pictus</i>	STEFANELLI (1949, 1951)
Pipidae	tongueless frogs, Zungenlose	
	Frösche	ZOTTOLI (1978b)
	<i>Xenopus laevis</i>	BILLINGS (1972), BILLINGS & SWARTZ (1969), STEFANELLI (1949)
Hylidae	<i>Hyla arborea</i>	STEFANELLI (1951), STEFANELLI & OSTI (1942)
	treefrogs, Laubfrösche	ZOTTOLI (1978b)
Ranidae	true frogs, Echte Frösche	ZOTTOLI (1978b)
	<i>Rana dalmatina</i>	STEFANELLI (1951), STEFANELLI & OSTI (1942)
	<i>Rana esculenta</i>	STEFANELLI (1951), STEFANELLI & OSTI (1942)
	<i>Rana pipiens</i>	LARSELL (1934), STEFANELLI (1951)
	<i>Rana temporaria</i>	STEFANELLI (1951), STEFANELLI & OSTI (1942)

TABELLE 2

Fische und Amphibien ohne Mauthnerzellen (Spezies ohne Literaturangabe wurden von uns untersucht)

Ordnung		
Familie	Art	Literatur
Myxiniformes		
Myxinidae	hagfishes, Inger	ZOTTOLI (1978b)
Rajiformes		
Rajidae	skates, Rochen	ZOTTOLI (1978b)
Torpedinidae	electric rays, Zitterrochen	ZOTTOLI (1978b)
	<i>Torpedo</i>	OTSUKA (1964a)
Lamniformes		
Lamnidae	requiem sharks,	
	Menschenhaie	ZOTTOLI (1978b)
Scyliorhinidae	catsharks, Katzenhaie	ZOTTOLI (1978b)
	<i>Scyliorhinus canicula</i>	BONE (1977), OTSUKA (1964a)

Anguilliformes		
Anguillidae	<i>Anguilla anguilla</i>	OTSUKA (1964a)
	<i>Anguilla japonica</i>	OTSUKA (1964a)
	freshwater eels, Süßwasseraale	ZOTTOLI (1978b)
Xencongridae	false morays, Falsche	
	Muränenale	ZOTTOLI (1978b)
Muraenidae	morays, Muränen	ZOTTOLI (1978b)
	<i>Muraena</i>	STEFANELLI (1951)
Nemichthyidae	<i>Avocettina</i>	BONE & MARSHALL (1983)
	<i>Nemichthys</i>	BONE & MARSHALL (1983)
Cyemidae	<i>Cyema</i>	BONE & MARSHALL (1983)
Congridae	conger eel, Meeraal	ZOTTOLI (1978b)
	<i>Conger conger</i>	OTSUKA (1964a), STEFANELLI (1951)
	<i>Congromuraena</i>	STEFANELLI (1951)
Serrivomeridae	<i>Serrivomer</i>	BONE & MARSHALL (1983)
Ophichthyidae	<i>Ophichthus</i>	OTSUKA (1964a)
	snake eels, Schlangenaale	ZOTTOLI (1978b)
Synphobranchidae	<i>Synphobranchus</i>	BONE & MARSHALL (1983)
Eurypharyngidae	<i>Eurypharynx</i>	BONE & MARSHALL (1983)
Derichthyidae	<i>Nessorhamphus</i>	BONE & MARSHALL (1983)
Siluriformes		
Aspredinidae	<i>Dysichthys coracoideus</i>	
	<i>Bunocephalichthys verrucosus</i>	
Gymnotiformes		
Gymnotidae	gymnotid eel, Messeraal	ZOTTOLI (1978b)
	<i>Gymnotus</i>	STEFANELLI (1951)
	<i>Gymnotus carapo</i>	
Stomiiformes		
Stomiidae	deepsea scaly dragonfishes,	
	Schuppendrachenfische	ZOTTOLI (1978b)
Batrachoidiformes		
Batrachoididae	<i>Opsanus tau</i>	ZOTTOLI (1978a)
	<i>Porichthys notatus</i>	ZOTTOLI (1978a)
	<i>Porichthys porosissimus</i>	ZOTTOLI (1978a)
	toadfishes, Krötenfische	ZOTTOLI (1978b)
Gobiesociformes		
Gobiesocidae	clingfishes, Schildfische	ZOTTOLI (1978b)
	<i>Lepadogaster</i>	OTSUKA (1964)
Lophiiformes		
Lophiidae	goosefishes, Anglerfische	ZOTTOLI (1978b)
	<i>Lophius americanus</i>	OTSUKA (1964a), ZOTTOLI (1978a)
	<i>Lophius piscatorius</i>	OTSUKA (1964a)
Antennariidae	frogfishes, Fühlerfische	ZOTTOLI (1978b)
	<i>Pterophryne histrio</i>	UCHIHASHI <i>et al.</i> (1960)
Ogcocephalidae	batfishes, Seefledermäuse	ZOTTOLI (1978b)
	<i>Ogcocephalus nasutus</i>	ZOTTOLI (1978a)
Melanocetidae	<i>Melanocetus</i>	BONE & MARSHALL (1983)
Oneirodiidae	<i>Oneirodes</i>	BONE & MARSHALL (1983)
Ceratiidae	<i>Cryptosaras</i>	BONE & MARSHALL (1983)
Gadiformes		
Ophidiidae	cusk-eel, brotulas,	
	Bartmännchen	ZOTTOLI (1978b)
	<i>Carapus acus</i>	
Beryciformes		
Cetomimidae	<i>Cetostomus</i>	BONE & MARSHALL (1983)

Syngnathiformes		
Syngnathidae	<i>Hippocampus guttulatus</i>	BENEDETTI <i>et al.</i> (1991)
	<i>Hippocampus hippocampus</i>	OTSUKA (1964a)
	pinefishes, seahorses,	
	Seenadeln, Seepferdchen	ZOTTOLI (1978b)
	<i>Syngnathus acus</i>	OTSUKA (1964a)
Scorpaeniformes		
Cyclopteridae	<i>Cyclopterus lumpus</i>	OTSUKA (1964a), ZOTTOLI (1978a)
	<i>Eumicrotremus orbis</i>	ZOTTOLI (1978a)
	lumpfishes, snailfishes,	
	Seehasen	ZOTTOLI (1978b)
	<i>Paraliparis</i>	BONE & MARSHALL (1983)
Perciformes		
Uranoscopidae	stargazers, Sterngucker	ZOTTOLI (1978b)
	<i>Uranoscopus scaber</i>	OTSUKA (1964a)
Tetraodontiformes		
Tetraodontidae	<i>Fugu rubripes</i>	Otsuka (1962, 1964a)
	puffer, Kugelfisch	ZOTTOLI (1978b)
	mola, Mondfisch	ZOTTOLI (1978b)
Molidae	<i>Mola mola</i>	OTSUKA (1962, 1964a)
	<i>Ranzania laevis</i>	OTSUKA (1962, 1964a)
Amphibia		
Anura		
Bufo	<i>Bufo viridis</i>	STEFANELLI (1949, 1951), ZACCHEI (1949)
	<i>Bufo vulgaris</i>	STEFANELLI (1949, 1951), ZACCHEI (1949)
	toads, Kröten	ZOTTOLI (1978b)

allen untersuchten Anguilliformes (11 Familien), Batrachoididae, Gobiesocidae, Lophiiformes (6 Familien) und Syngnathidae (Tabelle 2). Innerhalb mehrerer Ordnungen (Siluriformes, Gadiformes, Beryciformes, Scorpaeniformes und Perciformes) gibt es jeweils Familien mit und Familien ohne Mauthner Axone. Für die Gymnotidae und Tetraodontidae stehen Literaturangaben in Widerspruch zu eigenen Befunden. Für die Stomiidae, Ophidiidae und Uranoscopidae gibt es gegensätzliche Literaturangaben. Insgesamt sind bisher ca. 450 Fischarten (nur 2 %), ca. 200 Familien (ca. 40 %) und ca. 50 Ordnungen (ca. 90 %) geprüft. Die meisten besitzen Mauthner Axone (Tabelle 1). Nur bei ca. 60 Spezies aus 35 Familien und 18 Ordnungen fehlen sie (Tabelle 2). Die Mauthner Axone wurden innerhalb der Fische also mindestens ein dutzendmal unabhängig voneinander rückgebildet, wie ihre Verbreitung bei Agnatha, Gnathostomata, Chondrichthyes und Osteichthyes zeigt.

Von den 12 untersuchten Familien (32 untersuchte Arten) der Amphibien führen nur die Kaulquappen der Bufonidae als einzige keine Mauthner Axone. Alle anderen besitzen Mauthner Axone, teils nur als Kaulquappen, teils auch als Adulte (Tabelle 1). Das Vorkommen einer Schreckreaktion auf Schreckstoff ist innerhalb der Amphibien bisher nur von Kaulquappen einiger Bufonidae bekannt (EIBL-EIBESFELDT 1949, PFEIFFER 1966a, b). Dies zeigt, daß bei den Amphibien kein Zusammenhang zwischen Schreckreaktion und Mauthner Reaktion besteht.

Der Vergleich des Vorkommens von Mauthner Axonen mit dem Vorkommen von Schreckstoffzellen bei Ostariophysi (Tabelle 3) ergibt, daß von den 30 bisher geprüften Familien 22 beides besitzen. Zwei, nämlich Apterontidae und Loricariidae haben Mauthner Axone, doch fehlen ihnen Schreckstoffzellen und dementsprechend die Schreckreaktion. Umgekehrt wurden bei keiner einzigen Familie ohne Mauthner Axone Schreckstoffzellen gefunden. Den Aspredinidae fehlt beides. Den Gymnotidae fehlen Schreckstoffzellen, die Angaben über ihre Mauthner Axone sind widersprüchlich. Bei vier Familien (Lebiasinidae, Hemiodontidae, Ctenoluciidae und Crenuchidae) mit Mauthner Axonen ist der Besitz von Schreckstoffzellen unsicher. Wesentlich ist, daß alle Ostariophysi mit Schreckreaktion auf Schreckstoff auch Mauthner Axone besitzen.

TABELLE 3

Vergleich des Vorkommens von Mauthner Axonen und Schreckstoffzellen bei Ostariophysi.
+ vorhanden - fehlend ? fraglich. In Klammern die Anzahl der untersuchten Spezies. Daten zu Mauthner Axonen aus Tabelle 1 und 2. Daten zu den Schreckstoffzellen aus Pfeiffer (1977).

Ordnung Familie	Mauthner Axon	Schreckstoff- zellen	Ordnung Familie	Mauthner Axon	Schreckstoff- zellen
Gonorynchiformes	(3)	(6)	Gymnotiformes	(4)	(3)
Chanidae	+ (1)	+ (1)	Apterontidae	+ (3)	- (2)
Kneriidae	+ (1)	+ (4)	Gymnotidae	- (1)	- (1)
Phractolaemidae	+ (1)	+ (1)	Siluriformes	(24)	(30)
Characiformes	(22)	(58)	Ariidae	+ (1)	+ (4)
Anostomidae	+ (2)	+ (4)	Aspredinidae	- (2)	- (1)
Characidae	+ (10)	+ (41)	Bagridae	+ (3)	+ (4)
Citharinidae	+ (1)	+ (3)	Callichthyidae	+ (3)	+ (4)
Crenuchidae	+ (1)	? (1)	Clariidae	+ (3)	+ (4)
Ctenolucciidae	+ (1)	? (1)	Ictaluridae	+ (3)	+ (1)
Gasteropelecidae	+ (4)	+ (3)	Loricariidae	+ (1)	- (3)
Hemiodontidae	+ (1)	? (1)	Malapteruridae	+ (1)	+ (1)
Lebiasinidae	+ (2)	? (4)	Mochokidae	+ (1)	+ (2)
Cypriniformes	(27)	(53)	Plotosidae	+ (1)	+ (2)
Catostomidae	+ (2)	+ (3)	Schilbeidae	+ (2)	+ (1)
Cobitidae	+ (4)	+ (3)	Siluridae	+ (3)	+ (3)
Cyprinidae	+ (18)	+ (45)	Ostariophysi	(80)	(150)
Gyrinocheilidae	+ (1)	+ (1)			
Homalopteridae	+ (2)	+ (1)			

Ancistrus dolichopterus (Loricariidae) antwortet auf einen mechanischen (akustischen) Reiz mit einer Mauthner Reaktion, im Gegensatz zu den beiden Aspredinidae *Dysichthys coracoideus* und *Bunocephalichthys verrucosus*, denen Mauthner Axone fehlen. Alle drei Spezies verhalten sich also erwartungsgemäß. *Ancistrus* zeigt bei seiner Mauthner Reaktion zuerst (nach 20 ms) eine starke Körperkrümmung, danach einen schwächeren Gegenschlag (Abb. 4). Seine Winkelgeschwindigkeit erreicht binnen 20 ms 5300 Grad pro s und sinkt nach weiteren 20 ms nahe Null (Abb. 5). Auch die Translationsgeschwindigkeit erreicht nach 20 ms mit 20 Körperlängen



ABB. 4

Bewegungsmuster von *Ancistrus dolichopterus* bei der Mauthner Reaktion. Einzelbild-darstellung in 20 ms - Schritten, von oben gefilmt. Die Einzelbilder wurden jeweils gleichweit nach rechts versetzt gezeichnet.

pro s ihr Maximum und sinkt während der weiteren 20 ms deutlich (Abb. 5). Bei der Wendebewegung steigen weder Winkel- noch Translationsgeschwindigkeit wesentlich. Ihre Maxima liegen mit etwa 700 Grad pro s bzw. 3 Körperlängen pro s weit unter denjenigen bei einer Mauthner Reaktion (Abb. 6a). Auch die Wendebewegungen von *Dysichthys* (Abb. 6b) und *Bunocephalichthys* (Abb. 6c) verlaufen nur mit geringer Winkel- und Translationsgeschwindigkeit. Tag- und Nachtversuche zeigen völlig übereinstimmende Ergebnisse.

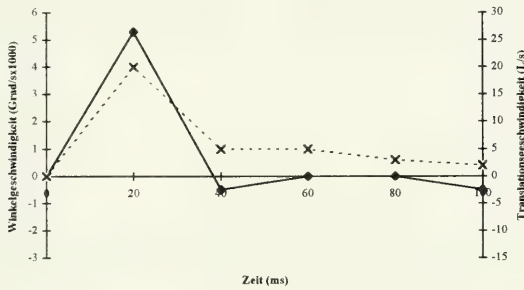


ABB. 5

Winkelgeschwindigkeit (—) und Translationsgeschwindigkeit (---) von *Ancistrus dolichopterus* bei einer am Tag durch einen akustischen Reiz ausgelösten Mauthner Reaktion.

Die Mittel-, Maximal- und Minimalwerte sowie die Standardabweichungen für alle Untersuchungsergebnisse an 3 Individuen von *Ancistrus* werden für die Winkelgeschwindigkeit (Abb. 7) und die Translationsgeschwindigkeit (Abb. 8) dargestellt. Die am Tag im Hellen erzielten Ergebnisse (Abb. 7a, 8a) werden mit den nachts im Dunkeln registrierten (Abb. 7b, 8b) verglichen. Die Ergebnisse bei der Mauthner Reaktion (Abb. 7, 8) werden denen bei Wendebewegungen (Abb. 9) gegenübergestellt. Der Unterschied zwischen beiden wird verdeutlicht durch "box & whisker plots" (Lorenz 1992) (Abb. 10). Bei der Mauthner Reaktion wurden maximale Winkelgeschwindigkeiten von 2300 bis 5300 Grad pro s gemessen, wogegen die Maxima bei der Wendebewegung nur 650 bis 850 Grad pro s betrugen (Abb. 10a). Der Mittelwert bei der Mauthner Reaktion ist mit 3400 etwa viermal höher als derjenige bei der Wendebewegung mit 750 Grad pro s. Bei der Translationsgeschwin-

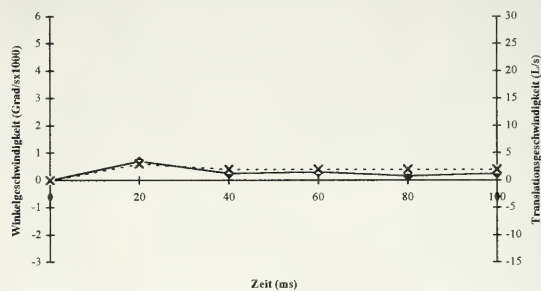


Abb. 6a.

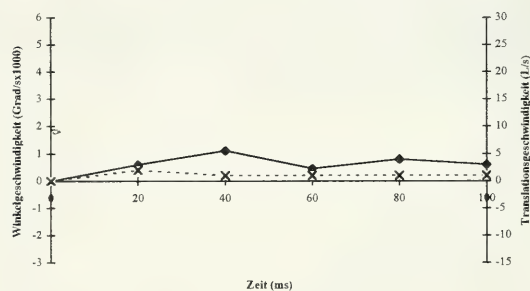


Abb. 6b.

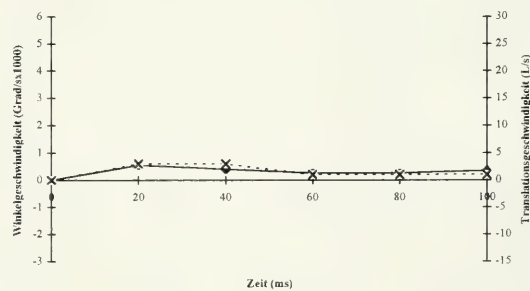


Abb. 6c.

ABB. 6

Vergleich der nächtlichen Wendebewegung von (a) *Ancistrus dolichopterus* (Loricariidae), (b) *Dysichthys coracoideus* (Aspredinidae) und (c) *Bunocephalichthys verrucosus* (Aspredinidae). Winkelgeschwindigkeit (—), Translationsgeschwindigkeit (---).

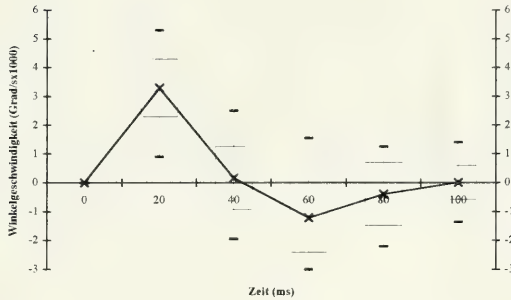


Abb. 7a.

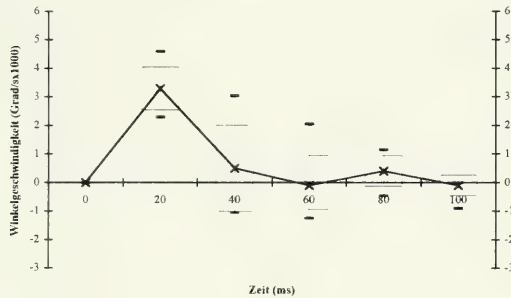


Abb. 7b.

ABB. 7

Winkelgeschwindigkeit bei der Mauthner Reaktion von *Ancistrus dolichopterus* (3 Individuen) auf einen akustischen Reiz (a) am Tag im Hellen (19 Versuche) und (b) nachts im Dunkeln (10 Versuche).

digkeit (Abb. 10b) werden bei der Mauthner Reaktion Höchstwerte von 6 bis 20 Körperlängen pro s erreicht, wogegen die Wendebewegungen nur mit einer maximalen Geschwindigkeit von 2-4 Körperlängen pro s verlaufen. Der Mittelwert für die Mauthner Reaktion liegt mit 15 Körperlängen pro s fünfmal so hoch wie derjenige für die Wendebewegung mit nur 3 Körperlängen pro s. Die Kopfbewegung von *Ancistrus* nach einer akustischen Reizung verläuft während der ersten 20 ms stereotyp. Die Kopfspitze beschreibt in jedem Versuch während dieses Zeitraums etwa denselben Weg (Abb. 11), wogegen der weitere Verlauf der Bewegung kein festes Schema aufweist.

DISKUSSION

Die Mauthner Axone, ein wesentlicher und hochspezialisierter Teil des ZNS Niederer Vertebraten (LARSELL 1967), sind im Laufe der Phylogenie etwa ein dutzendmal verloren gegangen. Während bei adulten Elasmobranchii, Anguilliformes

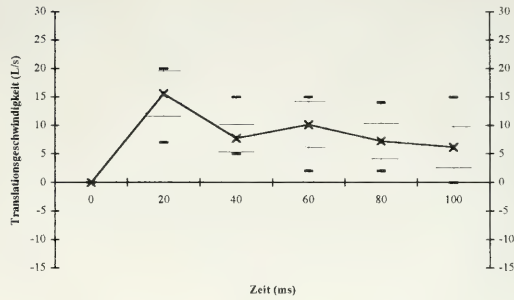


Abb. 8a.

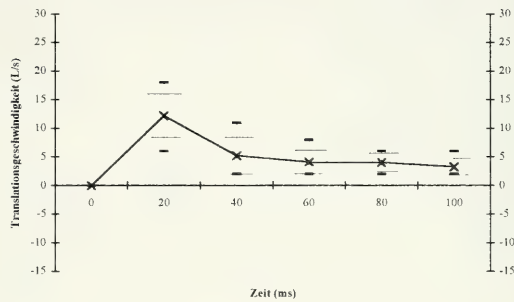


Abb. 8b.

ABB. 8

Translationsgeschwindigkeit bei der Mauthner Reaktion von *Ancistrus dolichopterus* (3 Individuen) auf einen akustischen Reiz (a) am Tag im Hellen (19 Versuche) und (b) nachts im Dunkeln (10 Versuche).

und vielen marinen Bodenfischen das Fehlen der Mauthner Axone von mehreren Autoren festgestellt wurde, gibt es für einige Arten und systematische Einheiten nur wenige Untersuchungen, z.B. die Myxinidae. Weitere vergleichende histologische Studien sind hier erforderlich. Der Befund an den Anguilliformes ist eindeutig. Bei ihnen bilden Dorsalis, Analis und Caudalis einen Flossensaum. Ihr langgestreckter Körper und ihre schlängelnde Fortbewegung erlauben keine Mauthner Reaktion. Adulten Elasmobranchii fehlen Mauthner Axone, in Embryonen haben sie nur einen geringen Durchmesser und wenige Kollateralen (BONE 1977). Ihr nur vorübergehendes Auftreten weist darauf hin, daß der Mauthner Apparat der Elasmobranchii ein Rudiment darstellt. Der Verlust ist verständlich, da die großen, am Ende der Nahrungskette stehenden, Haie und Rochen keine Fluchtreaktion benötigen. Mauthner Axone fehlen vielen Bodenfischen. Manche Gattungen wie *Blennius*, *Gobius*, *Trachinus* und *Solea*, die mit kräftigen Schwanzbewegungen schwimmen, besitzen Mauthner Axone. Flunder und Heilbutt zeigen keine Mauthner Reaktion wenn sie auf dem Grund liegen, wohl aber wenn sie schwimmen. Ihre visuelle Tarnung und ihr

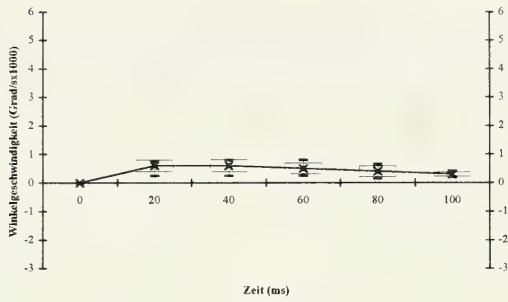


Abb. 9a.

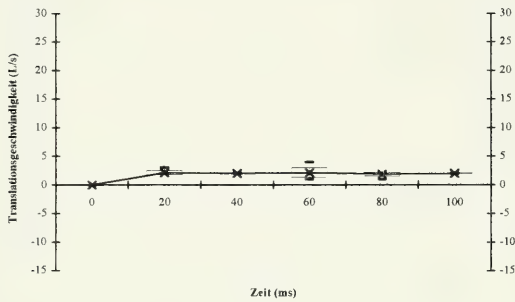


Abb. 9b.

ABB. 9

Wendebewegung von *Ancistrus dolichopterus* nachts im Dunkeln (7 Aufnahmen an 3 Individuen). (a) Winkelgeschwindigkeit, (b) Translationsgeschwindigkeit.

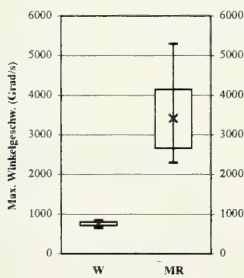


Abb. 10a.

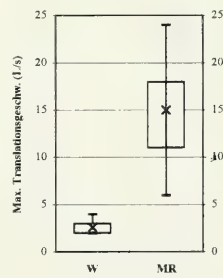


Abb. 10b.

ABB. 10

Vergleich der Mauthner Reaktion (MR, 29 Versuche) mit der Wendebewegung (W, 7 Filmaufnahmen) von *Ancistrus dolichopterus* (3 Individuen) durch „box & whisker plots“ (Lorenz 1992). (a) maximale Winkelgeschwindigkeit, (b) maximale Translationsgeschwindigkeit.

ruhiges Verhalten schützen diese Fische davor am Boden von Räubern gesehen zu werden (DE ANGELIS 1950, EATON *et al.* 1977, ZOTTOLI 1978a). Es besteht ein Zusammenhang zwischen dem Vorhandensein von Mauthner Axonen und der Verwendung des Schwanzschlags als Fluchtantwort. Schwanzlosen Fischarten und solchen mit geringer Schwanzflossenmotorik fehlen Mauthner Axone. Die, von der üblichen Fischgestalt abweichende Form, sowie der Antrieb durch die wellenförmige Bewegung der Rückenflosse bei Syngnathidae passen zum Fehlen von Mauthner Axonen. Der Schwanz wird nicht für den Schwimmstart verwendet (BENEDETTI *et al.* 1991). Die fischförmigen Gasterosteidae besitzen Mauthner Axone und eine Seitenlinie im Gegensatz zu den Syngnathidae, denen sie wohl nicht nahestehen. Während TRUYJILLO-CENOZ & BERTOLOTTO (1989) den Fund von Mauthner Axonen bei *Gymnotus carapo* meldeten, fanden STEFANELLI (1951) und ZOTTOLI (1978b) in Übereinstimmung mit unseren eigenen Beobachtungen (Abb. 3c) keine Mauthner Axone. Auch die anatomischen Merkmale sprechen gegen ihr Vorhandensein: Dorsalis, Caudalis und Ventralis fehlen, die Analis bildet den einheitlichen als Antriebsorgan dienenden Flossensaum. Mit Ausnahme der Aale besitzen die mesopelagischen Fische Mauthner Axone, selbst Familien mit einem langen schlanken Körper wie Stomiidae, Trichiuridae und Zoarcidae. Mesopelagische Fische sind räuberischen Angriffen besonders ausgesetzt. Bathypelagischen Tiefseefischern (*Melanocetus*, *Cryptopsaras* und *Oneirodes*) fehlen Mauthner Axone ebenso wie dem Seeteufel *Lophius*. Durch ihre Tarnung am Boden sind sie vor Räubern geschützt; außerdem stehen sie z.T. selbst am Ende der Nahrungskette. Die Macrouridae und Notacanthidae besitzen Mauthner Axone trotz ihres langen, spitzen Schwanzes. Die Mauthner Reaktion von *Nematonurus armatus* (Macrouridae) führt zu einem Aufwärtssprung vom Boden (WOLFF 1971). Macrouridae, Halosauridae und Notacanthidae verlieren oft ihr Schwanzende an Räuber. Durch die Mauthner Reaktion können sie ihren Schwanz schützen. Der benthische Tiefseefisch *Bathypterois* steht auf den verlängerten Strahlen seiner Brustflossen und Schwanzflosse wie auf einem Dreibein. Dieser gut getarnte Grundfisch kann sich mit Hilfe seiner kräftigen Schwanzflosse vor Räubern wie *Bathysaurus*, Tiefseehaien oder Synphobranchidae mit seiner Mauthner Reaktion retten.

Während die Urodelen Mauthner Axone besitzen, sind diese bei den Gymnophionen und Anuren nur im Larvalzustand (Kaulquappen) vorhanden. Allen Bufonidae fehlen Mauthner Axone sogar als Kaulquappen, die nur einen kleinen Schwanz mit kleiner Flosse und ein kaum entwickeltes Seitenlinienorgan besitzen. Die Adulten sind terrestrisch. Die Mehrzahl der Anuren (*Rana*, *Hyla*, *Discoglossus* u.a.) hat großschwänzige Kaulquappen mit einem gut entwickelten Seitenlinienorgan und Mauthner Axonen. Wenige Anuren mit aquatischer Lebensweise (*Xenopus*) besitzen Kaulquappen mit mächtigem Schwanz und hochentwickeltem Seitenlinienorgan, das bei ihrer Metamorphose nicht reduziert wird. Bei ihren Kaulquappen ist der Mauthner Apparat stärker ausgeprägt als bei den vorher genannten (STEFANELLI 1949). Möglicherweise steht die Rückbildung der Mauthner Axone in Zusammenhang mit dem Verschwinden des Seitenlinienorgans, das über Dendriten mit den Mauthner Zellen verbunden ist. Der Mauthner Apparat existiert, wenn sowohl das sensorische System

des Seitenlinienorgans als auch das motorische System des Schwanzes vorhanden ist. Die Kaulquappen der Bufonidae haben als einzige Amphibien die Mauthner Axone und damit die Mauthner Reaktion im Laufe der Phylogenie verloren; sie haben als einzige Amphibien als wichtigen Schutz gegen den Verlust durch räuberische Überfälle eine Schreckreaktion auf den Schreckstoff aus der Haut von Artgenossen entwickelt (EIBL-EIBESFELDT 1949, PFEIFFER 1966a, b).

Innerhalb der Fische ist eine ähnliche Schreckreaktion auf einen Schreckstoff aus der Haut von Artgenossen bekannt (VON FRISCH 1938, 1941a, b). Die Schreckreaktion ist Besitz der meisten Ostariophysi *sensu lato* (d.h. Anotoptysi oder Gonorynchiformes plus Otophysi, nämlich Siluriformes, Characiformes und Cypriniformes). Der Schreckstoff entstammt besonderen epidermalen Schreckstoffzellen (PFEIFFER 1960, 1963, 1967). Die histologischen Ergebnisse über das Vorkommen von Mauthner Axonen bei Ostariophysi (Tabelle 1, 2) werden erstmals mit denjenigen über das Vorhandensein von Schreckstoffzellen (Pfeiffer 1977) verglichen (Tabelle 3). Nur die Aspredinidae und Gymnotidae haben beides rückgebildet, sowohl die Mauthner Axone als auch die Schreckstoffzellen. Die Rückbildung muß aufgrund der Verbreitung angenommen werden. Beide Familien sind nachtaktive Einzelgänger. Während den Gymnotidae die Schwanzflosse fehlt, besitzen die Aspredinidae einen dünnen, langen Schwanzstiel mit reduzierter Muskulatur. Auch die Loricariidae und Apterodontidae haben Schreckstoffzellen und Schreckreaktion rückgebildet, unter Beibehaltung ihrer Mauthner Axone. Auch sie sind nachtaktive Einzelgänger; dies macht den Verlust ihrer Schreckreaktion verständlich. Die Apterodontidae besitzen eine Schwanzflosse, die Loricariidae eine Schwanzmotorik, die ihnen bemerkenswerte Mauthner Reaktionen erlaubt. Wie Verhaltensexperimente zeigten, besitzt *Ancistrus dolichopterus* (Loricariidae) eine Mauthner Reaktion, im Gegensatz zu *Dysichthys coracoideus* (Aspredinidae) und *Bunocephalichthys verrucosus* (Aspredinidae). Die Ergebnisse passen zu den histologischen Befunden. Die graphische Auswertung der Mauthner Reaktion von *Ancistrus dolichopterus* zeigt eine plötzliche Erhöhung der Winkel- und Translationsgeschwindigkeit. Der Versuchsfisch wurde akustisch gereizt wenn er ruhig am Boden lag. Während der schnellen Körperkrümmung erreichte er die größte Winkel- und Translationsgeschwindigkeit (bis zu 5300 Grad/s und 20 Längen/s). Die erste Phase der Mauthner Reaktion ist beendet, wenn sich die Winkelgeschwindigkeit Null Grad nähert. Zu diesem Zeitpunkt beginnt der Gegenschlag. Er ist durch die relativ hoch bleibende Translationsgeschwindigkeit gekennzeichnet. Durch die schnelle Körperkrümmung bringt der Fisch seinen verletzbaren Kopf aus der Gefahrenzone und leitet den kräftigen Schwanzschlag ein. Zwischen den am Tag im Hellen erzielten Mauthner Reaktionen und den nachts im Dunkeln registrierten besteht kein Unterschied. EATON *et al.* (1977a) haben eine Latenzzeit der Reaktion von 5-10 ms festgestellt. Sie arbeiteten mit einer besser auflösenden Videoanlage (1 Bild in 5 ms). Aufgrund der geringen zeitlichen Auflösung (1 Bild in 20 ms) konnte unsere Videoanlage nicht immer die Extremwerte erfassen. Bei der Auswertung von mehreren Bewegungen zeigt sich, daß die Reaktion innerhalb der ersten 20 ms mit einer stereotypen Bewegung von Kopf und Schwanz nach einer Seite abläuft. Der Gegenschlag des Schwanzes ist nicht stereotyp, d.h. der

Winkel der neuen Schwimmrichtung nicht voraussagbar. Daß es sich bei den dargestellten Auswertungen um Mauthner Reaktionen handelt, zeigt der Vergleich mit einer Wendebewegung von *Ancistrus dolichopterus*. Hier treten nur geringe Winkel- und Translationsgeschwindigkeiten auf. Die beiden Aspredinidae *Dysichthys cora-coideus* und *Bunocephalichthys verrucosus* antworten auf akustische Reizung nicht mit einer Mauthner Reaktion, entsprechend den histologischen Ergebnissen. Es konnte nur ihre Wendebewegung registriert werden, die sich nicht von derjenigen des *Ancistrus* unterscheidet. Zwischen einer ausgeprägten Schwanzmotorik und dem Besitz von Mauthner Neuronen besteht ein Zusammenhang. Die Aspredinidae schwimmen mit „Düsenantrieb“ indem sie Wasser unter Druck aus den Kiemen-spalten ausstoßen. Ihre Schwanzstielmuskulatur ist reduziert. Nur bei einer gut ent-wickelten Schwanzmuskulatur kann die Mauthner Reaktion von Fischen genutzt werden. Wenn die körperlichen Voraussetzungen nicht gegeben sind, geht der Mauthner Apparat verloren, wie im Laufe der Phylogenie bei den Ostariophysi zwei-mal, innerhalb der Teleostei öfter als ein dutzendmal geschehen.

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Die Asteiidae (Diptera) der Schweiz

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The Asteiidae (Diptera) of Switzerland. - A study of all specimens of Asteiidae ever collected in Switzerland and stored in Swiss collections revealed that 7 species occur in this country; six of them are reported here for the first time. For all specimens exact localities and dates are given. An illustrated key is provided for the identification of the 8 Central European species.

Key words: Diptera - Asteiidae - Key - Switzerland

EINLEITUNG

Es ist nicht erstaunlich, dass die Asteiiden zu den unbekanntesten Dipterenfamilien in Mitteleuropa gehören: Die Fliegen sind sehr klein und unscheinbar, sie leben ziemlich versteckt und fallen trotz der gelegentlich auftretenden Schwarmbildung kaum in Erscheinung. Nur sehr wenige Publikationen sind bisher über ihre Biologie erschienen. FREIDBERG (1984) beschreibt minutiös das Paarungs- und Territorialverhalten von *Asteia elegantula* und erwähnt kurz einige Verhaltensweisen der Imagines von *Asteia amoena*. Von der letzteren Art berichten PERRY & STUBBS (1978), dass sich die Larven im Saftstrom von Bäumen entwickeln. Die Larven der anderen schweizerischen Gattung, *Leiomyza*, ernähren sich von Pilzen (PAPP 1972; CHANDLER 1978). Erstaunliches weiss man von der 3. Gattung, die in Mitteleuropa vorkommt, *Astiosoma*: Deren Imagines findet man auf Asche frisch abgebrannter Wälder (CHANDLER 1978).

Weltweit sind bis heute etwa 130 Arten bekannt (FREIDBERG 1984), wovon etwa 30 Arten in 4 Gattungen in der Palaearktis vorkommen (PAPP 1984). Die meisten Arten sind entweder zentralasiatisch oder mediterran verbreitet, während nur 8 Arten aus 3 Gattungen bis nach Mitteleuropa vordringen. Die ungenügende Bearbeitung der Familie zeigt sich unter anderem darin, dass die meisten der 17 Arten Israels noch unbeschrieben sind (FREIDBERG 1988).

Zur Zeit läuft in der Schweiz ein Katalog-Projekt zur Erfassung der Dipterenfauna (MERZ *et al.*, in Vorb.). Dabei wurden sämtliche in den Sammlungen der Schweiz aufbewahrten Asteiidae untersucht. Bis heute ist für die Schweiz einzig

Leiomysa laevigata gemeldet (MEIER & SAUTER 1989). Eine Nachbestimmung dieses Tieres mit Untersuchung der Terminalia ergab allerdings, dass es sich um *L. dudai* handelt. Damit sind die übrigen sechs aufgelisteten Arten Neufunde für die Schweiz.

Im folgenden wird neben der detaillierten Angabe der Funde auch ein Bestimmungsschlüssel präsentiert. Es sollte ein einfacheres Erkennen aller mittel- und nordeuropäischen Arten ermöglichen.

MATERIAL UND METHODEN

Insgesamt wurden 308 Individuen untersucht, die in den folgenden Sammlungen aufbewahrt werden:

1. Entomologische Sammlung ETH Zürich (ETHZ)
2. Muséum d'histoire naturelle, Genève (MHNG) (D. Burckhardt)
3. Musée d'Histoire Naturelle, Neuchâtel (MHNN) (J.P. Haenni, Ch. Dufour)
4. Musée Zoologique, Lausanne (MZL) (M. Sartori)
5. Naturhistorisches Museum der Burgergemeinde Bern (NHBB) (Ch. Huber)
6. Naturhistorisches Museum Basel (NHMB) (M. Brancucci)
7. Natur-Museum Chur (NMC) (J.P. Müller)
8. Zoologisches Museum der Universität Zürich (ZMUZ) (G. Bächli)
9. Sammlung B. Merz (CBM)

In der Entomologischen Sammlung des Natur-Museums Luzern (R. Reser) wurden keine Asteiidae gefunden.

Zum Sammeln der Asteiidae bieten sich 2 erfolgsversprechende Methoden an: a) für *Asteia* das Käschern der Vegetation, wobei die Tiere häufig auf Sträuchern am Waldrand gefunden werden. Besonders günstig sind feuchtere Wälder (z.B. Auenwälder), wo die Fliegen manchmal recht zahlreich um die Blüten fliegen. b) *Leiomysa*-Arten wurden in grosser Anzahl auf Bananenköder gesammelt (Methode nach BÄCHLI & BURLA 1985). Manchmal werden die Tiere durch ausfliessende Baumsäfte und faulende Substanzen angelockt.

Die Terminologie im Schlüssel richtet sich im wesentlichen nach MCALPINE (1981). Die Abbildungen wurden anhand von Glycerinpräparaten mit einem Zeichentubus angefertigt (Methode nach MERZ 1994).

BESTIMMUNGSSCHLÜSSEL FÜR DIE GATTUNGEN UND ARTEN DER ASTEIIDAE IN MITTELEUROPA

Als Grundlage für den vorliegenden Schlüssel dienen die Arbeiten von DUDA (1934), SABROSKY (1956), SHTAKELBERG (1969) und CHANDLER (1978). Leider fehlen in allen 3 Arbeiten Arten, die in der Schweiz vorkommen. Deshalb wird hier ein neuer Schlüssel präsentiert, der für alle Arten Mitteleuropas gültig ist.

- 1 Ader r_1 lang, verläuft sehr lange parallel der Costa und mündet viel näher der r_{2+3} als der sc in die Costa (Abb. 2); ein Paar kräftige, prokline Orbitalborsten vorhanden (Abb. 4); Arista fast nackt, deren Haare höchstens wenig dicker als die Dicke der Aristabasis; Tiere mit schwarzem Thorax (*Leiomyza*) 5
- Ader r_1 kurz, mündet viel näher der sc als der r_{2+3} in die Costa (Abb. 1); Orbitalborste entweder reklinat (Abb. 3) oder sich von übriger Behaarung der Stirn nicht unterscheidend; Arista fast kahl oder gefiedert (Abb. 3); zumindest Pleuren des Thorax vorherrschend gelb 2
- 2 Querader dm-cu fehlt und Alula wenig entwickelt (Abb. 1); Arista mit langen Fiederhaaren und Orbitalborste kräftig, reklinat (Abb. 3) (*Asteia*) 3
- Querader dm-cu vorhanden, Alula stärker entwickelt; Arista fast kahl, keine differenzierte, kräftige Orbitalborste vorhanden *Astiosoma rufifrons* Duda [Nur aus Grossbritannien und dem ehemaligen Jugoslawien bekannt; ausführliche Beschreibung und Illustrationen bei CHANDLER, 1978]
- 3 Gesicht über dem Mundrand mit einem Paar glänzender, schwarzer Flecken (Abb. 5); Stirn gelb; Scutum glänzend dunkelbraun bis schwarz gefärbt, mit 1 Paar hellerer Längsstreifen vor der Suturalquer-naht; Pleuren kontrastierend gelb glänzend; Scutellum auf der Dorsal-fläche schwarz, entlang der Seite gelb; Halteren völlig gelb: Surstyli nur schwach asymmetrisch (Abb. 7-9) *Asteia concinna*
- Gesicht über dem Mundrand mit einem silbrigglänzenden, schwarz berandeten Querband (Abb. 6); Scutellum einheitlich gelb; Halteren nicht völlig gelb; Surstyli kräftig asymmetrisch (Abb. 10-16) 4
- 4 Scutum schwarz, Pleuren gelb gefärbt; Stirn schwarz, nur am Vorderrand über der Lunula mit hellem Band; Halterenkopf gleichmässig verdunkelt; rechter Surstylus grösser als der linke, rinnenförmig (Abb. 10-13) *Asteia amoena*
- Thorax rötlich gefärbt, auf dem Scutum mit zwei Paar dunklerer Längsstreifen auf der Rückenfläche und einem Paar entlang der Notopleuralnaht; Stirn orange-braun, etwas längsgestreift erscheinend; Halterenkopf gelb mit grossem, schwarzem Fleck; rechter Surstylus viel grösser als der linke, schaufelförmig (Abb. 14-16) *Asteia elegantula*
- 5 Halterenkopf gelb gefärbt, f_3 völlig gelb gefärbt 6
- Halterenkopf schwärzlich gefärbt, f_3 völlig gelb oder mit dunklem Ring an der Basis 7
- 6 Dorsozentralborsten um weniger als ihre Länge vom Scutellumrand entfernt inseriert (Abb. 17); Cerci mit sehr langen Haaren, welche die Spitze der Surstyli erreichen (Abb. 19, 20); Aedeagus mässig sklerotisiert, Spitze membranös, leicht verbreitert (Abb. 21, 22) *Leiomyza curvinervis*
- Dorsozentralborsten viel weiter als ihre eigene Länge vom Scutellumrand entfernt, etwa auf der Höhe des Notopleuralhinterrandes inseriert (Abb. 18); Cerci kürzer behaart, erreichen nicht die Spitze der

- Surstyli (Abb. 23, 24); Aedeagus sehr schwach sklerotisiert, Spitze membranös, nicht verbreitert (Abb. 25) *Leiomyza scatophagina*
- 7 Dorsozentralborsten um weniger als ihre Länge vom Scutellumrand entfernt inseriert (Abb. 17); f₃ subapikal verdunkelt; Innerer Surstylus gleichmässig gegen die Spitze verjüngt (Abb. 29, 30); Aedeagus stark sklerotisiert, mit sklerotisierter, becherförmiger Spitze (Abb. 31) *Leiomyza laevigata*
- Dorsozentralborsten etwa auf der Höhe der Flügelbasis inseriert, vom Scutellumhinterrand viel weiter entfernt als ihre maximale Länge (Abb. 18); f₃ völlig gelb; Innerer Surstylus an der Spitze mit kleinem Haken (Abb. 26, 27); Aedeagus stark sklerotisiert, Spitze unregelmässig becherförmig (Abb. 28) *Leiomyza dudai*

ARTENLISTE

Die Nomenklatur im folgenden Katalog richtet sich nach PAPP (1984). Die Lokalitäten werden alphabetisch nach Kanton und Ortschaft aufgeführt. Dabei werden die Kantone wie folgt abgekürzt: AG = Aargau; BE = Bern; BL = Baselland; BS = Baselstadt; FR = Fribourg; GE = Genève; GR = Graubünden; JU = Jura; LU = Luzern; NE = Neuchâtel; SG = St. Gallen; SH = Schaffhausen; TI = Ticino; VD = Vaud; VS = Valais; ZH = Zürich. In Klammern stehen alle Funddaten einer Fundstelle. Die allgemeine Verbreitung wurde PAPP (1984) und lokalen Faunenlisten entnommen. Die Länder sind von Norden nach Süden, und von Westen nach Osten geordnet.

Asteia amoena Meigen, 1830

(Abb. 1, 3, 6, 10-13)

AG: 1 ♀, Würenlingen (26.VII.1990) (Bächli) (ZMUZ). BE: 2 ♀, Biel (27-31.VII.1973) (Bächli) (ZMUZ); 1 ♂, Lamboing, Près de Macolin Derrière (16.V.1993) (Merz) (ETHZ). BS: 1 ♂, Basel (1.III.1961) (Keiser) (NHMB). FR: 1 ♀, Bonaudon (16.IX.1956) (Aubert) (MZL). GE: 1 ♂, Chancy, La Laire (20.VII.1995) (Burckhardt) (MHNG). GR: 1 ♂, Rothenbrunnen (19.VIII.1993) (Merz) (CBM). JU: 1 ♂, Courrendlin, vers vielle Eglise, Mini-Malaise-Falle (13.-27.X.1988) (Gonseth) (MHNN). SH: 1 ♀, Rüdlingen (2/3.VII.1994) (Merz & Eggenberger) (ETHZ). TI: 1 ♂, 1 ♀, Arcegno (8-11.VIII.1970) (Bächli) (ZMUZ); 6 ♂, 3 ♀, Biasca-Loderio (15.III.1994, 31.III.1994, 9.IV.1995, 8.VI.1992, 16-20.VI.1995) (Merz) (CBM, ETHZ, ZMUZ); 4 ♂, 4 ♀, Bolle di Magadino (17-20.VI.1995, Fangzelt, 19.VI.1995) (Bächli) (ZMUZ); 1 ♂, Brusino (3.IV.1988) (Merz) (ETHZ); 1 ♀, Gordola (17-20.VI.1995, Fangzelt) (Bächli) (ZMUZ); 3 ♂, 2 ♀, Maggia (10-12.IX.1991) (Bächli) (ZMUZ). VD: 1 ♂, 1 ♀, Aigle (4-7.VIII.1970) (Bächli) (ZMUZ); 1 ♂, 6 ♀, Aigle (8.VI.1955, 2.VII.1955, 20.VI.1956, 30.V.1957, 2.VI.1957) (Passello) (MZL); 1 ♂, Hauteville (28.VI.1955) (Passello) (MZL); 1 ♂, Jorat (30.IX.1948) (Schmid) (MZL); 3 ♂, St. Sulpice (VII.1945) (Schmid) (MZL); 1 ♂, St. Triphon (9.V.1955) (Passello) (MZL); 1 ♂, Vidy-Lausanne (24.IX.1954) (Schmid) (MZL). VS: 1 ♀, Hochtenn-Bahnhof (3.IX.1991) (Merz) (ETHZ); 1 ♂, Muraz (24.V.1959) (Passello) (MZL); 1 ♂, Vionnaz (2.VI.1957) (Passello) (MZL). ZH: 5 ♂, 7 ♀, Dietikon (10-14.IX.1985, 5.VIII.1989, 11-14.IX.1989, 19-23.VII.1990, 13.VI.1991, 22.VIII.1991, 27-31.VIII.1991, 15-19.VII.1993, 14-18.VII.1995) (Bächli) (ZMUZ); 1 ♀, Dietikon-Reppisch (22-25.VIII.1982) (Bächli) (ZMUZ); 1 ♀, Dübendorf (17.IX.1993) (Gautschi) (ETHZ); 1 ♂, Flaach/Thurauen (1.IX.1993) (Merz) (CBM); 1 ♀, Zürich (10.VIII.1991) (Merz) (ETHZ); 1 ♂, Zürich (14-

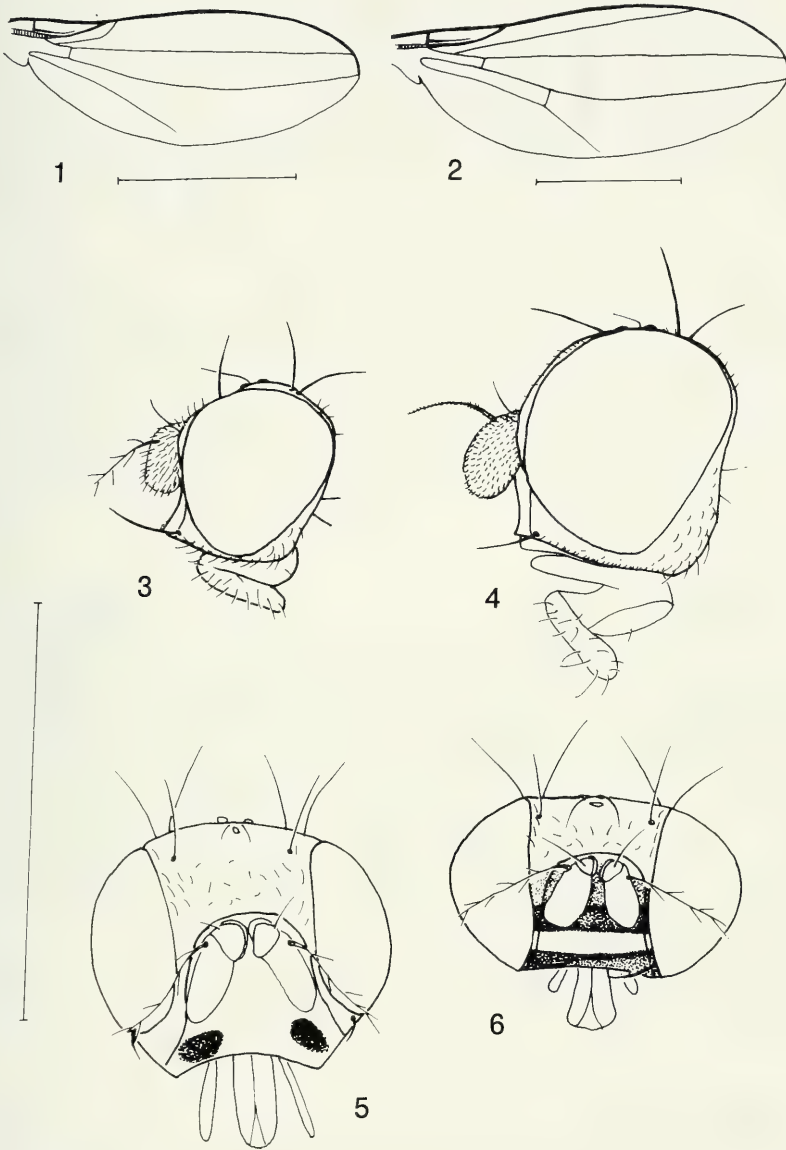


ABB. 1-6

Flügel und Köpfe von Asteiidae. 1-2, Flügel. 1, *Asteia amoena* Meigen (♂, ZH, Zürich-Örlikon, 29.V.1991); 2, *Leiomyza curvinervis* (Zetterstedt) (♂, VS, Visperterminen, 18.VII.1995). 3-6, Köpfe. 3, *Asteia amoena* Meigen, Profil (♂, ZH, Zürich-Örlikon, 29.V.1991); 4, *Leiomyza curvinervis* (Zetterstedt), Profil (♂, VS, Visperterminen, 18.VII.1995); 5, *Asteia concinna* Meigen, Frontal (♂, TI, Biasca-Loderio, 28.VI.1992); 6, *Asteia amoena* Meigen, Frontal (♂, ZH, Zürich-Örlikon, 29.V.1991). Massstab: 1 mm.

16.IX.1973) (*Bächli*) (ZMUZ); 2♀, Zürich-Allmend (1.V.1995, 7.VII.1993) (*Merz*) (CBM, ETHZ); 2♂, 3♀, Zürich-Hönggerberg (15-19.VII.1989, 18-22.VII.1991, 16-20.VII.1994, 14-18.VII.1995) (*Bächli*) (ZMUZ); 6♂, 2♀, Zürich-Katzensee (23.VII.1991, 30.VIII.1992) (*Bächli*) (ZMUZ); 6♂, 1♀, Zürich-Örlikon (9.V.1993, 23.V.1992, 29.V.1991) (*Merz*) (CBM, ETHZ); 1♀, Zürich-Zürichberg (17.IX.1992) (*Merz*) (CBM).

Allgemeine Verbreitung: Grossbritannien, Schweden, Belgien, Deutschland, Polen, Schweiz, Österreich, ehem. Tschechoslowakei, Ungarn, Italien, Kanarische Inseln.

Bemerkungen:

1. Ein kleiner Schwarm von ca. 15 Tieren wurde jeweils im Mai und Juni von 1991-1995 regelmässig unter einem Strauch beobachtet, dessen Äste über ein steiles Wiesenbord ragten und so eine geschützte Höhlung bildeten. Die Tiere schwebten ausdauernd an immer derselben Stelle.

2. Die Form eines Surstylus und des Aedeagus wird in CHANDLER (1978) und PAPP (1979) abgebildet. Unsere Untersuchungen zeigen, dass vor allem die Form des rechten Surstylus recht variabel ist, und von schmal zylindrisch bis schwach zylindrisch reicht (Abb. 10, 11).

Asteia concinna Meigen, 1830

(Abb. 5, 7-9)

BE: 1♂, Schwarzenburg (8.VII.1993) (*Baur*) (NHBB). BL: 2♀, Birsfelden (13.VI.1989) (*Merz*) (CBM, ETHZ). GE: 5♂, 1♀, Russin (17. & 27. VI.1954) (*Aubert*) (MZL). GR: 1♀, Ardez (16.VIII.1991) (*Merz*) (CBM); 1♀, S. Niclè (21.VIII.1961) (*Keiser*) (NHMB). LU: 1♀, St. Urban, Lehmgrube (24.VI.1994) (*Merz*) (CBM). NE: 1♀, Le Locle, 1000m, sous Monts Or (11.VIII.1987) (*Haenni*) (MHNN); 1♀, St. Blaise, Les Riedes (21.VI.1988) (*Haenni*) (MHNN). TI: 4♂, 6♀, Biasca-Loderio (28.VI.1992, 5. VII.1991) (*Merz*) (CBM, ETHZ); 2♀, Bolle di Magadino (19.VI.1995) (*Bächli*) (ZMUZ). VD: 1♂, 2♀, Aigle (2.VII.1955) (*Passello*) (MZL); 4♀, Ferreyres (2.VII.1971) (*Aubert*) (MZL); 1♀, Mormont (21.VI.1970) (*Aubert*) (MZL). VS: 2♂, 1♀, Follatères (6.VII.1958) (*Aubert*) (MZL); 1♂, Guttet (27-31.VII.1993) (*Bächli*) (ZMUZ). ZH: 1♂, Dietikon (13.VI.1991) (*Bächli*) (ZMUZ); 1♂, Zürich, Waldschlag (14.VIII.1987) (*Merz*) (ETHZ); 2♂, 3♀, Zürich-Allmend (14.VI.1995, 5.VII.1995, 7.VII.1993) (*Merz*) (CBM, ETHZ).

Allgemeine Verbreitung: Grossbritannien, Finnland, Belgien, Deutschland, Polen, Schweiz, Österreich, ehem. Tschechoslowakei, Ungarn.

Asteia elegantula Zetterstedt, 1847

(Abb. 14-16)

GR: 1♂, 1♀, Rothenbrunnen (9.VI.1993) (*Merz*) (ETHZ). TI: 5♂, 1♀, Biasca-Loderio (28.VI.1992, 17.VI.1995) (*Merz*) (CBM, ETHZ); 1♂, 1♀, Gordola (11.IX.1989, 19.V.1991) (*Merz*) (CBM). VS: 1♀, Bitsch (14.VII.1989) (*Merz*) (ETHZ); 1♀, Guttet (27-31.VII.1993) (*Bächli*) (ZMUZ); 2♂, 1♀, Leuk-Brentjong (1.VI.1991, 12.VIII.1993) (*Merz*) (CBM, ETHZ). ZH: 1♂, 2♀, Dietikon (13.VI.1991) (*Bächli*) (ZMUZ).

Allgemeine Verbreitung: Grossbritannien, Finnland, Schweden, Deutschland, Polen, Schweiz, Österreich, ehem. Tschechoslowakei, Ungarn.

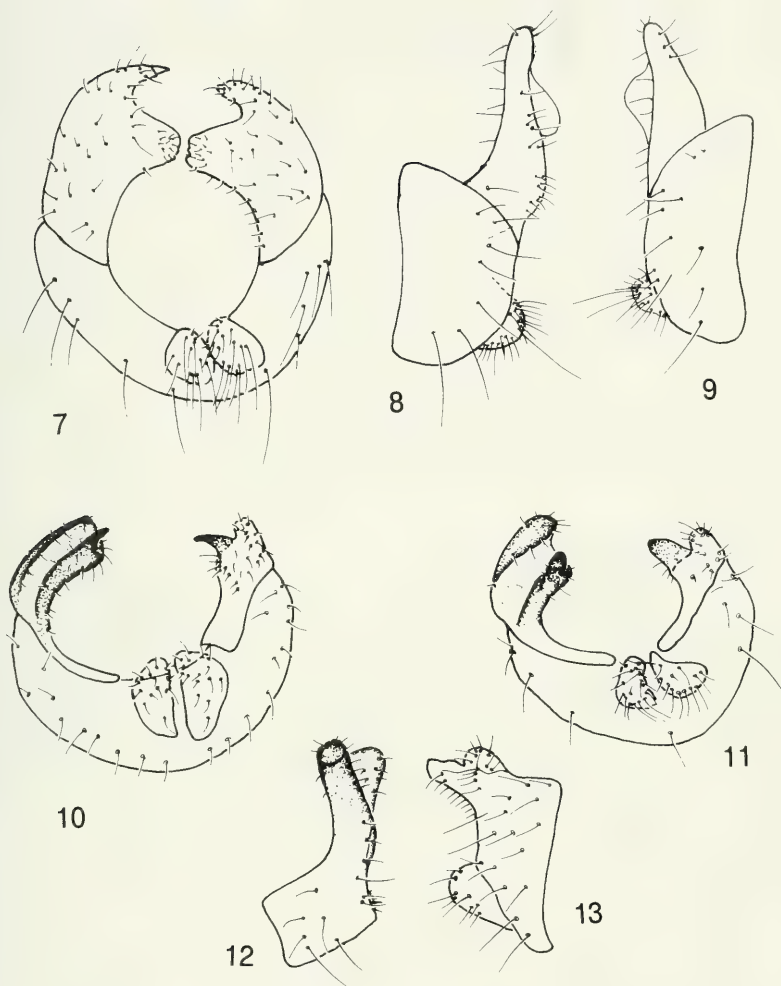


ABB. 7-13

Terminalia von *Asteia*. 7-9. *A. concinna* Meigen, Epandrium mit Surstyli. 7, Caudalansicht; 8, Lateralansicht rechts; 9, Lateralansicht links (TI, Biasca-Loderio, 28.VI.1992). 10-13. *A. amoena* Meigen, Epandrium mit Surstyli. 10, Caudalansicht (ZH, Zürich-Katzensee, 23.VII.1991); 11, Caudalansicht (TI, Bolle di Magadino, 17-20.VI.1995); 12, Lateralansicht rechts (ZH, Zürich-Katzensee, 23.VII.1991); 13, Lateralansicht links (TI, Biasca-Loderio, 28.VI.1992).

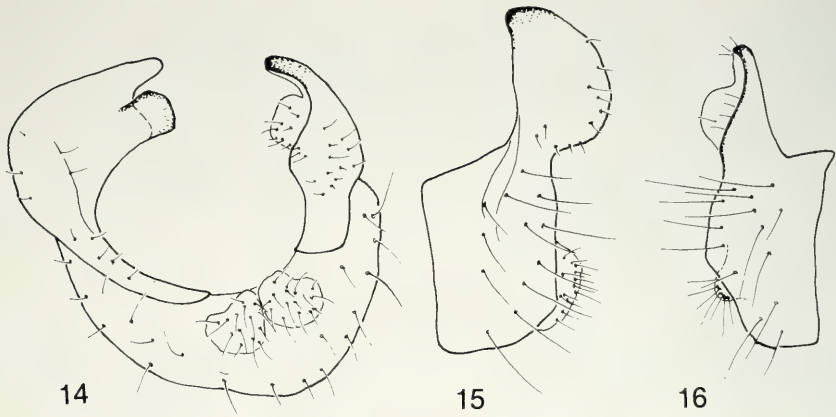


ABB. 14-16

Asteia elegantula Zetterstedt, Epandrium mit Surstyli. 14, Caudalansicht; 15, Lateralansicht rechts; 16, Lateralansicht links (TI, Biasca-Loderio, 28.VI.1992).

***Leiomyza curvinervis* (Zetterstedt, 1838)**

(Abb. 2, 4, 19-22)

GR: 2♂, Alp Flix (4-8.VIII.1975) (*Bächli*) (ZMUZ); 1♂, Ausserferrera (11.IX.1994) (*Merz & Eggenberger*) (CBM); 2♂, Lenzerheide (11-14.VIII.1988) (*Bächli*) (ZMUZ); 1♂, Savognin (17-20.VIII.1988) (*Bächli*) (ZMUZ); 9♂, 3♀, Scuol (9-12.VIII.1978) (*Bächli*) (CBM, ZMUZ); 1♂, Zernez (15-18.VIII.1978) (*Bächli*) (ZMUZ). SG: 1♀, Rheineck (14-17.VIII.1973) (*Bächli*) (ZMUZ). VS: 2♂, 1♀, Bürchen (20-22.VIII.1993) (*Bächli*) (ZMUZ); 2♂, 5♀, Guttet (31.VII-2.VIII.1993) (*Bächli*) (ZMUZ); 1♀, Hochtenn-Bahnhof (3.IX.1991) (*Merz*) (CBM); 1♀, Leuk (23.VIII-2.IX.1977) (*Bächli*) (ZMUZ); 1♂, 2♀, Visperterminen (18.VII.1995, 24.VII.1991) (*Sauter, Merz*) (ETHZ).

Weiterer Fund: Montenegro: 2♀, Durmitor (30.VII-5.VIII.1988) (*Bächli*) (ZMUZ).

Allgemeine Verbreitung: Schweden, Deutschland, Polen, Schweiz, Österreich, ehem. Tschechoslowakei, Montenegro. Neartik.

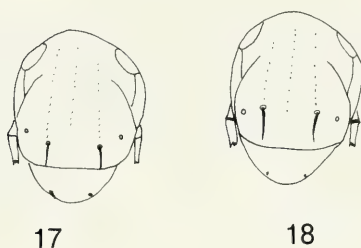
***Leiomyza dudai* Sabrosky, 1956**

(Abb. 18, 26-28)

AG: 1♂, Villnachern (10.VIII.1986) (*Meier*) (ETHZ). GR: 1♀, Zernez, Gondas (17.VII.1930) (*Keiser*) (NMC). SH: 1♀, Rüdlingen (2-3.VII.1994) (*Merz & Eggenberger*) (CBM). ZH: 2♂, 6♀, Dietikon (10-14.VIII.1982, 10-14.IX.1985, 6-10.IX.1987, 19-23.VII.1990, 18-22.VII.1991, 27-31.VIII.1991, 16-20.VII.1992) (*Bächli*) (ZMUZ); 1♀, Zürich-Allmend (17.V.1995) (*Merz*) (CBM); 1♀, Zürich-Hönggerberg (14-19.VII.1988) (*Bächli*) (ZMUZ); 1♀, Zürich-Käferberg (12-15.VIII.1987) (*Gosteli*) (ZMUZ).

Allgemeine Verbreitung: Grossbritannien, Finnland, Deutschland, Polen, Frankreich, Schweiz, Österreich, ehem. Tschechoslowakei, Ungarn, Italien.

Bemerkung: An der Form des ♂ Hypandriums sehr einfach zu erkennen: Die inneren Surstyli tragen eine abgewinkelte Spitze (Abb. 26-27).

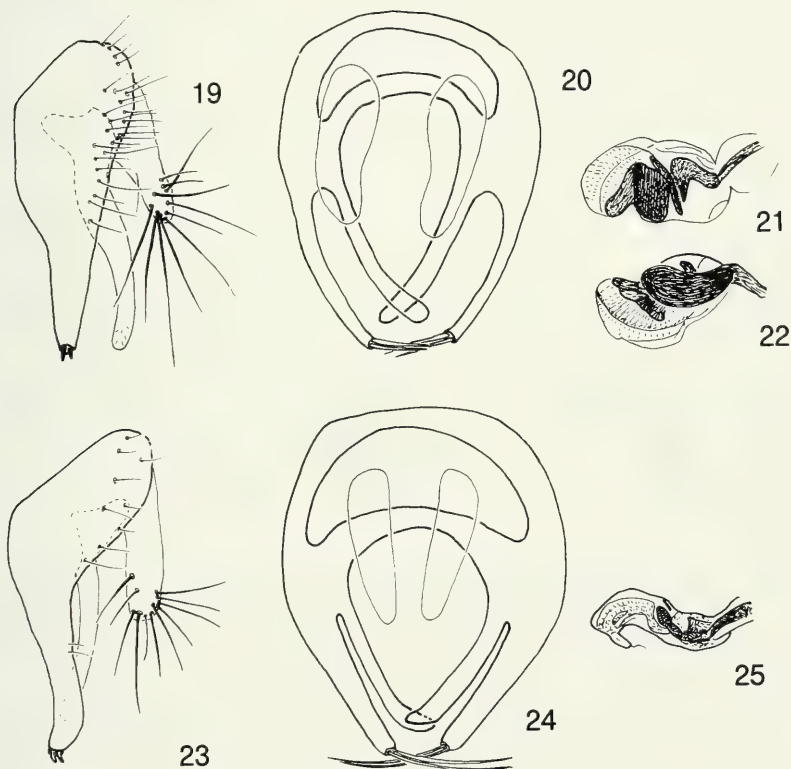


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18

ABB. 17-18

Stellung der Dorsozentralborsten bei *Leiomysza*; eingetragen sind nur die wichtigsten Borsten und die Flügelansatzstelle. 17, *L. laevigata* (Meigen) (VS, Visperterminen, 19.VII.1995); 18, *L. dudai* Sabrosky (AG, Villnachern, 19.VIII.1986).



23

24

25

ABB. 19-25

Terminalia von *Leiomysza*. 19-22, *L. curvinervis* (Zetterstedt). 19, Epandrium und Surstyli, Lateralansicht; 20, Caudalansicht; 21 & 22 Aedeagus in zwei verschiedenen Ansichten (VS, Visperterminen, 18.VII.1995). 23-25, *L. scatophagina* (Fallén). 23, Epandrium und Surstyli, Lateralansicht; 24, Caudalansicht; 25, Aedeagus (VS, Hochtenn-Bahnhof, 3.IX.1991).

***Leiomyza laevigata* (Meigen, 1830)**

(Abb. 17, 29-31)

GR: 1 ♂, 5 ♀, Savognin (17-20.VIII.1988) (*Bächli*) (ZMUZ). NE: 1 ♀, Rochefort (5-8.VII.1982) (*Bächli*) (ZMUZ). VS: 3 ♂, 2 ♀, Bürchen (7-13.VIII.1993) (*Bächli*) (CBM, ZMUZ); 1 ♂, Gletsch (18.VII.1991) (*Merz*) (CBM); 16 ♂, 28 ♀, Guttet (27-31.VII.1993) (*Bächli*) (ZMUZ); 2 ♂, 1 ♀, Leuk (23.VIII-2.IX.1977, 27-29.VII.1993) (*Bächli*) (ZMUZ); 4 ♂, Visp (13-15.VIII.1993) (*Bächli*) (ZMUZ); 1 ♀, Visperterminen, Wald (19.VII.1993) (*Merz*) (ETHZ).

Weiterer Fund: Montenegro: 14 ♂, 4 ♀, Durmitor (30.VII-5.VIII.1988) (*Bächli*) (ZMUZ).

Allgemeine Verbreitung: Grossbritannien, Finnland, Schweden, Deutschland, Polen, Schweiz, Österreich, ehem. Tschechoslowakei, Ungarn, Montenegro. Nearktis.

***Leiomyza scatophagina* (Fallén, 1823)**

(Abb. 23-25)

GR: 1 ♀, Savognin (17-20.VIII.1988) (*Bächli*) (ZMUZ). NE: 1 ♂, 1 ♀, Rochefort (5-8.VII.1982) (*Bächli*) (ZMUZ); 1 ♀, E de Valengin, 750m (31.V.1979) (*Haenni*) (MHNN). VS: 1 ♂, Hochtenn-Bahnhof (3.IX.1991) (*Merz*) (CBM).

Weiterer Fund: Montenegro: 1 ♀, Durmitor (30.VII-5.VIII.1988) (*Bächli*) (ZMUZ).

Allgemeine Verbreitung: Grossbritannien, Schweden, Finnland, Deutschland, Belgien, Polen, Schweiz, Österreich, ehem. Tschechoslowakei, Montenegro. Nearktis.

DISKUSSION

Obwohl bis heute keine systematischen Fangpläne zur Erfassung der *Asteiidae* der Schweiz durchgeführt wurden, konnten in den Sammlungen der Schweiz sieben der acht bekannten Arten Mitteleuropas festgestellt werden. Dieser Befund unterstreicht anschaulich die zentrale Lage der Schweiz in Mitteleuropa, aber auch die noch vorhandene Diversität von Biotop-Typen. Als besonders reichhaltig können das Wallis und Graubünden angesehen werden, wo jeweils sechs Arten gefunden wurden. In diesen beiden Kantonen dürfte noch die grösste Ausdehnung naturnaher Biotope vorkommen.

Eine ökologische Differenzierung zeigt die Verbreitung der beiden in der Schweiz vorkommenden Gattungen: Alle *Asteia*-Arten findet man nebst Wallis und Graubünden auch im Tessin und im Kanton Zürich und zeigen damit eine Präferenz für wärmere Biotope. Möglicherweise können diese drei Arten überall in der Schweiz in tiefen Lagen gefunden werden. Generell gilt *Asteia* als Gattung mediterraner und eremischer Gebiete. Vor allem in Israel und Nordafrika ist sie arten- und individuenreich (FREIDBERG 1988). Andere Verhältnisse zeigt *Leiomyza*, deren Vertreter in der Schweiz vor allem im Alpenraum vorkommen, einzig *L. dudai* dringt in tiefere Lagen vor. Ein weiteres Indiz für die Präferenz montaner Lagen von *Leiomyza* zeigt deren Verbreitung in Europa: Während in der ehemaligen Tschechoslowakei mit gebirgiger Landschaft alle vier Arten vorkommen, sind aus dem gut untersuchten, aber sehr flachen Ungarn nur zwei Arten bekannt.

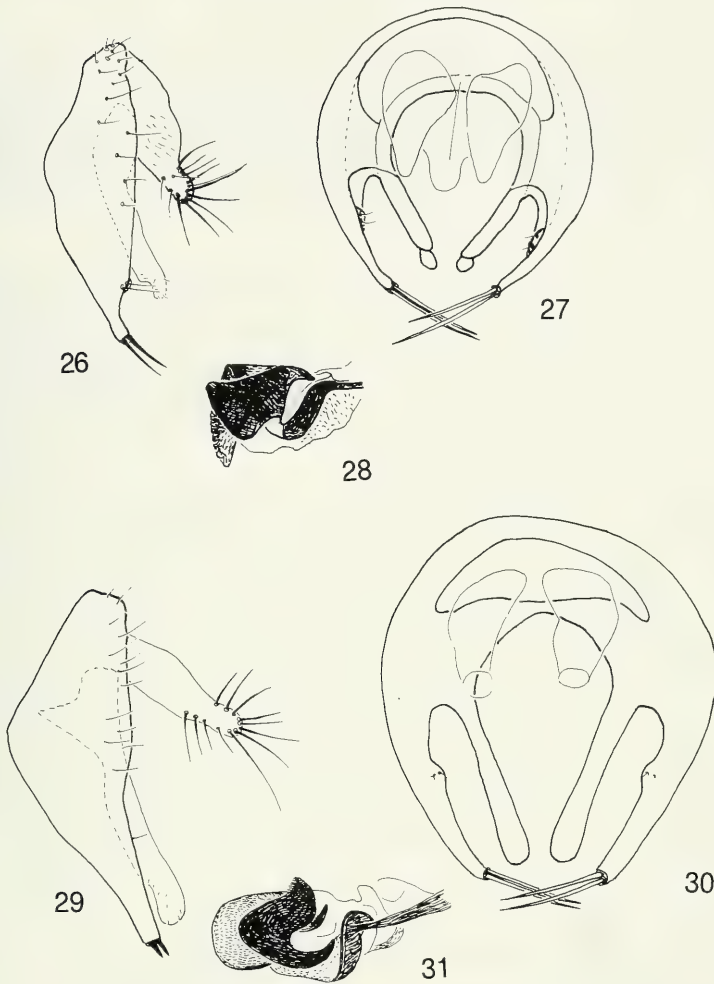


ABB. 26-31. Terminalia von *Leiomysza*. 26-28, *L. dudai* Sabrosky. 26, Epandrium und Surstyli, Lateralansicht; 27, Caudalansicht; 28, Aedeagus (AG, Villnachern, 19.VIII.1986). 29-31, *L. laevigata* (Meigen). 29, Epandrium und Surstyli, Lateralansicht; 30, Caudalansicht; 31, Aedeagus (VS, Gletsch, 18.VII.1991).

Interessanterweise kommen an gewissen Fundstellen, wie z.B. Biasca-Loderio, Dietikon oder Savognin mehrere Arten offenbar sympatrisch miteinander vor. In Biasca wurden zahlreiche Tiere von allen 3 *Asteia*-Arten auf blühenden *Salix* und anderen Sträuchern gekäschert. Diese Tendenz zur Aggregation ist auch aus Israel bekannt, wo verschiedene *Asteia* und *Phlebosotera* manchmal unter *Tamarix*-Sträuchern Schwärme bilden (FREIDBERG 1984, eigene Beobachtungen). Der Grund für dieses Verhalten ist unbekannt, könnte mit ähnlichem Paarungsverhalten oder ähnlicher Larvallebensweise zusammenhängen.

VERDANKUNGEN

Ganz herzlich danke ich allen oben aufgeführten Konservatoren für die Erlaubnis, die jeweiligen Insektensammlungen nach Asteiiden durchzukämmen. Ein weiterer grosser Dank geht an M. Eggenberger für die Durchsicht des Manuskriptes und an K.Tschudi-Rein für die Kontrolle der englischen Zusammenfassung.

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***Molostrongylus acanthocolpos* gen. n., sp. n., (Nematoda, Trichostrongylina, Molineoidea) parasite de *Molossops temmincki* (Chiroptera, Molossidae) au Paraguay**

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***Molostrongylus acanthocolpos* gen. n. sp. n. (Nematoda, Trichostrongylina, Molineoidea) parasite of *Molossops temmincki* (Chiroptera, Molossidae) from Paraguay.** - A new genus and species are described from the intestine of the bat *Molossops temmincki* in Paraguay. It belongs to a group of genera which possesses a cephalic hood. The new taxon appears closely related to *Anoplostrongylus*, but may be distinguished mainly by the characters of the caudal bursa in male and by the presence of spines in the ovejector region in female.

Key-words: Nematoda - Molineoidea - Anoplostrongylinae - *Molostrongylus* gen. n. - Molossidae - Paraguay.

INTRODUCTION

Parmi les Anoplostrongylinae parasites de Chiroptères, trois genres possèdent une tête dépourvue d'épines et de crochets mais pourvue d'un capuchon céphalique (DURETTE-DESSET & CHABAUD, 1975): *Torrestrongylus* Perez-Vigueras, 1935 et *Tricholeiperia* Travassos, 1935 tous deux néotropicaux et *Anoplostrongylus* Boulenger, 1926 présent à la fois dans l'Ancien Monde chez *Tupaia* et dans le Nouveau Monde chez les Chauve-Souris.

Un abondant matériel de Nématodes Trichostrongles a été récolté chez les Chauve-souris du Paraguay au cours des différentes missions du Muséum d'histoire naturelle de Genève à partir de 1979. Cette note concerne la description d'une nouvelle espèce appartenant à un genre nouveau, parasite de l'intestin de Molossidae qui, par ses caractères céphaliques, appartient à ce groupe.

MATÉRIEL ET MÉTHODES

Les Nématodes ont été fixés au formol à 4% et conservés dans de l'alcool à 70°. Ils sont déposés dans les Collections du Muséum d'histoire naturelle de Genève (MHNG) et dans celles du Muséum national d'histoire naturelle de Paris (MNHN).

Molostrongylus n.gen.

Molineoidea, Molineidae, Anoplostrongylinae. Nématodes de petite taille ne présentant aucun enroulement. Tête avec capuchon céphalique en deux parties. Synopse avec axe d'orientation ventro-dorsal confondu avec l'axe sagittal. Présence d'ailes latérales fortement développées. Bourse caudale de type 2-3, allongée transversalement avec côtes 2 et 3 de longueur équivalente à celle des 4 et des 6. Côtes 5 plus longues que les côtes adjacentes. Côte dorsale longue, divisée à son extrémité distale. Côtes 8 plus courtes que la côte dorsale. Spicules non ailés en forme de cône allongé, à pointe unique et mousse. Gubernaculum présent. Chez la femelle, présence d'épines cuticulaires dans la région de l'ovéjecteur; queue plus haute que large avec trois grosses pointes et un filament médian.

Parasite de Chiroptères néotropicaux.

Espèce-type: *Molostrongylus acanthocolpos* n.sp.

Molostrongylus acanthocolpos n.sp.

Matériel type: ♂ holotype, MHNG 21111 INVE, ♀ allotype 21112 INVE, 8 ♂, 6 ♀, 1 immature ♀, paratypes 21113 INVE. chez *Molossops temminckii* Estancia General Diaz, dépt. Alto Paraguay, Paraguay, 18.11.1987.

Autre matériel: 7 ♂ MHNG 21120 INVE, 7 ♂, 2 ♀ MHNG 21121 INVE, 4 ♂, 4 ♀, 1 morceau postérieur ♀, 2 morceaux antérieurs MNHN 934 MD. comme holotype; 2 morceaux antérieurs ♀ MHNG 21114 INVE, pont sur le Rio Aguaray, dépt. Misiones, 16.10.1982; 2 ♂, 1 ♀, 1 morceau antérieur ♀ MHNG 21115 INVE, Panchito Lopez, dépt. Neembucu, 24.10.1982; 7 ♂ MHNG 21116 INVE, 9 ♂, 8 ♀ MNHN 188 KP, Santa Maria, dépt. Misiones, 27.10.1982; 1 ♂, 2 ♀ MNHN 932 MD, arroyo Tagatija-mi, env. de l'estancia Santa Maria, dépt. Concepción, 14.10.1983; 1 ♂, 2 ♀, 2 morceaux postérieurs ♀ MHNG 21117 INVE, arroyo Tagatija-guazu, env. de l'estancia Santa Maria, dépt. Concepción, 15.10.1983; 1 ♂, 2 ♀ MNHN 933 MD, Monte Lindo, route Transchaco km 212, 23.08.1984; 3 ♂ MHNG 21118 INVE, Belén, dépt. Concepción, 11.10.1985; 1 ♂, 1 morceau antérieur MHNG 21119 INVE, estancia Apendice, route Transchaco km 293, dépt. Presidente Hayes, 8.11.1985.

Petits Nématodes ne présentant aucun enroulement. Pore excréteur situé au niveau de la deuxième moitié de l'oesophage, très en arrière du bord antérieur des glandes excrétrices. Glandes excrétrices très développées (fig. 3 E). Sinus excréteur d'abord dirigé vers l'avant. Deirides de forme triangulaire et en position latéro-dorsale, plus ou moins proches du pore excréteur mais toujours situées plus antérieurement que celui-ci. Oesophage présentant une légère constriction dans sa partie médiane (fig. 3 D).

Tête: Présence d'une vésicule céphalique composée de deux parties: une partie antérieure en forme de capuchon et une partie postérieure, généralement plus longue. Présence d'une petite dent oesophagienne dorsale (fig. 3 A, B). En vue apicale,

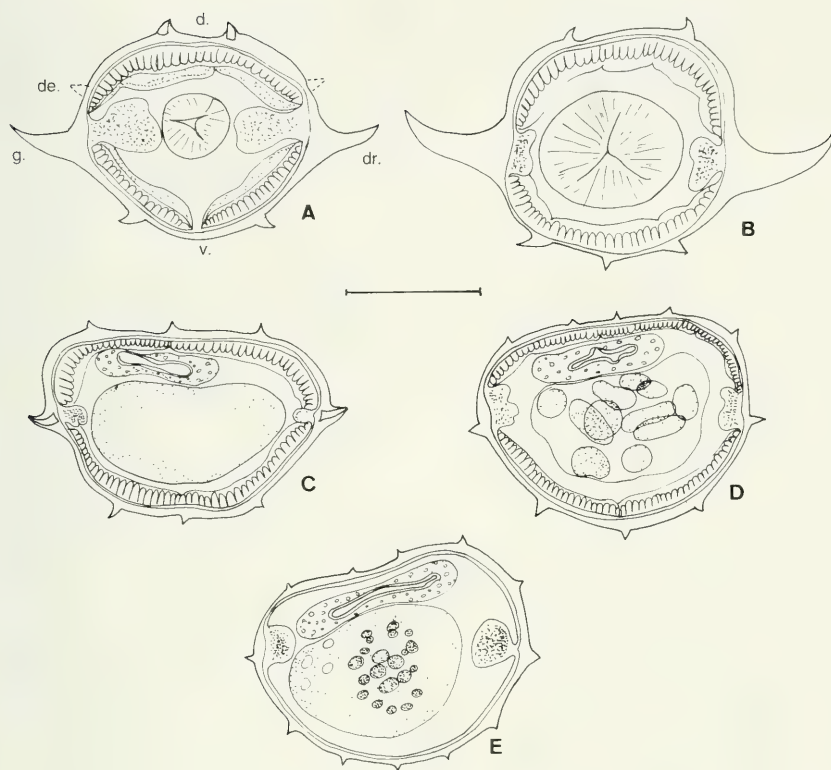


FIG. 1

Molostrongylus acanthocolpos n. gen. n. sp. Mâle (long de 3200 μm). Coupes transversales du corps A - au niveau des deirides. B - à 420 μm en arrière de la tête. C - au milieu du corps (à 1750 μm de la tête). D - à 1200 μm en avant de la bourse caudale. E - à 700 μm en avant de la bourse caudale. Toutes les coupes sont orientées comme la figure A. Abréviation: de. = deiride, d. = dos, g. = gauche, v. = ventre, dr. = droite. Echelle: 30 μm .

bouche arrondie entourée de deux grosses amphides, de 4 papilles labiales externes (2 dorsales et 2 ventrales) et de quatre papilles céphaliques. Dorsalement, entre la bouche et les papilles céphaliques existe une mince plaque en arc de cercle qui suit le contour de la bouche. Cette plaque est pourvue de trois épaissements, un à chaque extrémité et un médian (fig. 3 A, C).

Synopse: (étudié en coupe transversale du corps chez 3 mâles et 3 femelles paratypes ainsi que 2 mâles et 2 femelles du matériel complémentaire). Dans les deux sexes, le corps est parcouru par des crêtes cuticulaires continues dont le nombre augmente d'avant en arrière mais à des niveaux différents pour chacun des deux sexes.

En arrière de la vésicule céphalique naissent deux ailes latérales qui atteignent leur maximum de largeur (25 μm) au niveau de la jonction oesophago-intestinale puis

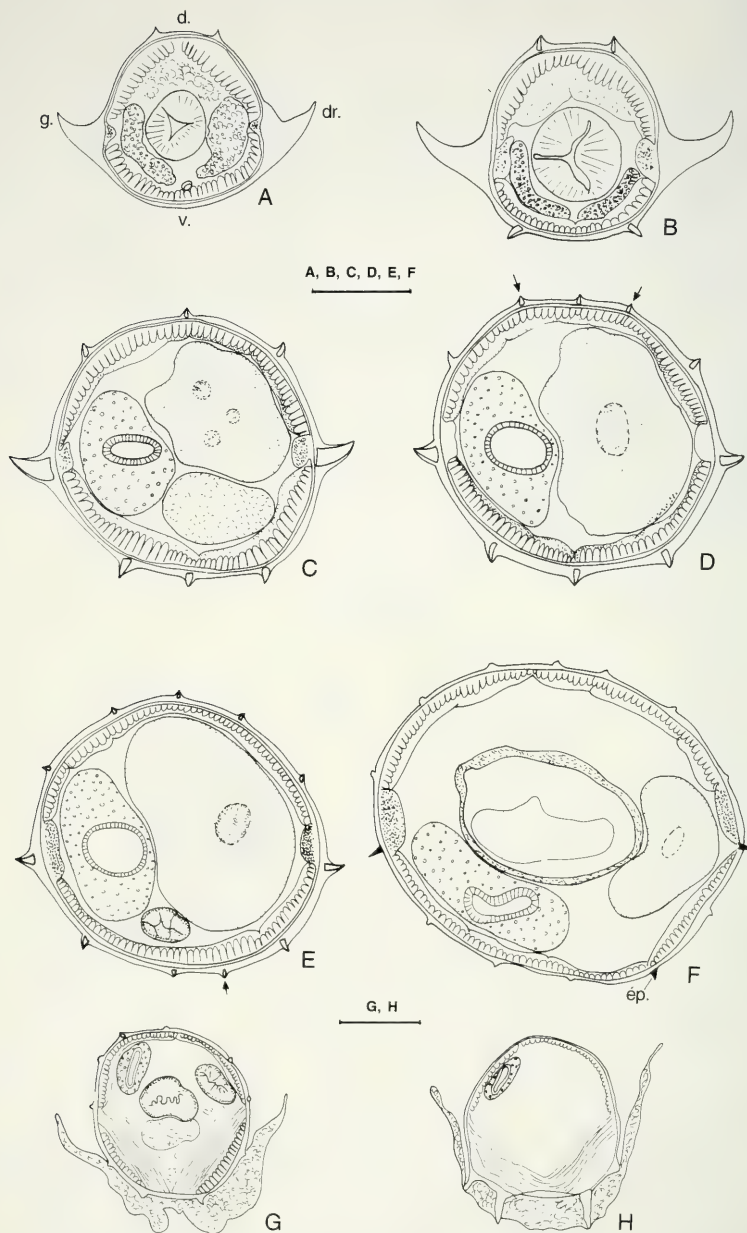


FIG. 2. *Molostrongylus acanthocolpos* n. gen. n. sp. Femelle (longue de 5200 μm). Coupes transversales du corps. A - au niveau du pore excréteur. B - à 460 μm en arrière de la tête. C - à 1450 μm en arrière de la tête. D - à 2000 μm en arrière de la tête., montrant la naissance de 2 crêtes dorsales. E - au milieu du corps (à 2350 μm en arrière de la tête), montrant la naissance d'une crête ventrale. F - juste en avant de l'anneau copulateur. G - H: autre femelle, synopse en avant et en arrière de la vulve, montrant l'anneau copulateur. Toutes les coupes sont orientées comme la figure A. Abréviations: ép. = épine, d. = dos, g. = gauche, v. = ventre, dr. = droite. Les flèches indiquent la naissance de nouvelles crêtes cuticulaires. Echelles: A - F: 30 μm ; G, H, 50 μm .

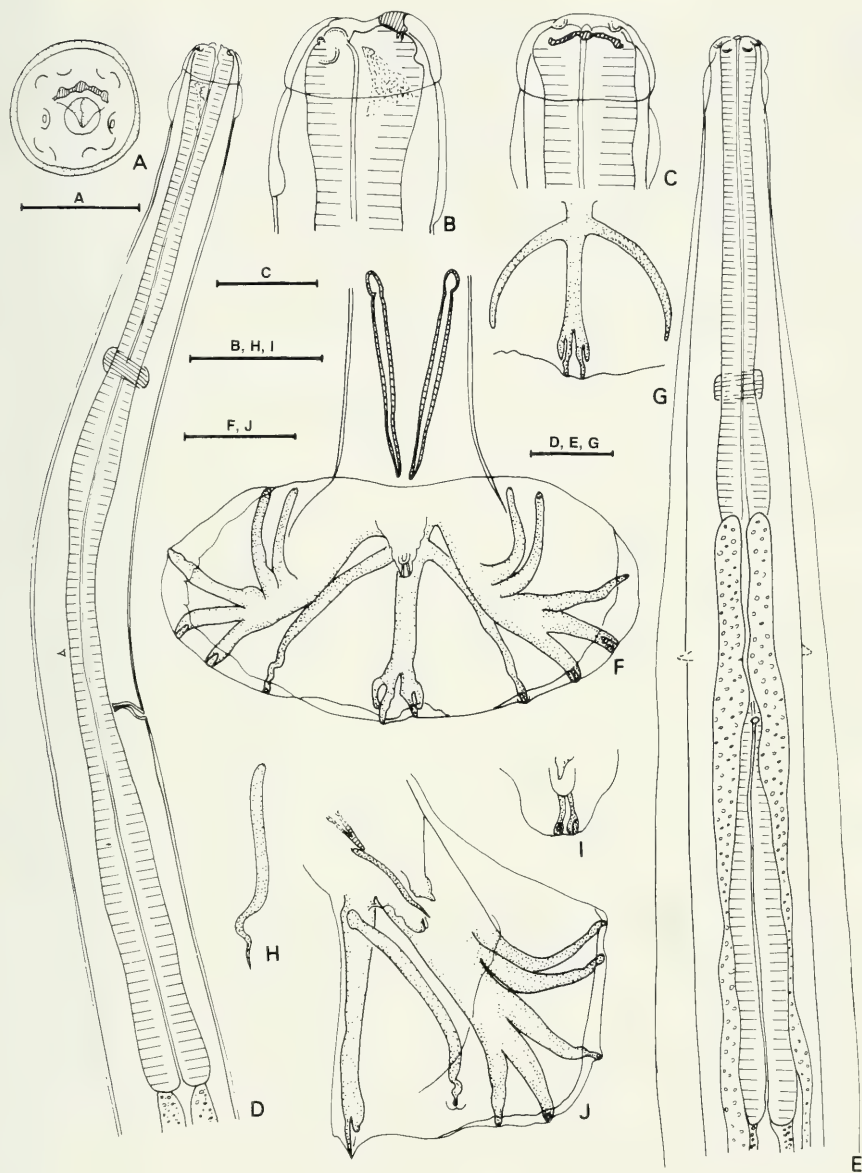


FIG. 3. *Molostrongylus acanthocolpos* n. gen. n. sp. A - femelle, tête en vue apicale. B - autre femelle, tête en vue latérale gauche. C - mâle, tête en vue dorsale. D - mâle, extrémité antérieure, vue latérale droite. E - id, vue ventrale, montrant la position latero-dorsale des deirides et le fort développement des glandes excrétrices. F - mâle, bourse caudale, vue ventrale. G - autre mâle, détail des côtes 8 et de la côte dorsale, vue dorsale. H - mâle, gubernaculum, vue latérale droite. I - mâle, cône génital, vue ventrale. J - autre mâle, bourse caudale, vue latérale droite. Echelles: A: 50 μ m ; B, H, I: 30 μ m ; C: 20 μ m ; D, E, G: 40 μ m ; F, J: 50 μ m.

la largeur des ailes décroît progressivement d'avant en arrière mais elles restent toujours plus développées que les autres crêtes sauf en avant de la vulve chez la femelle. Les ailes disparaissent à environ 200 μm en avant de la bourse caudale chez le mâle et au niveau de la vulve chez la femelle.

Dans les deux sexes et chez la majorité des individus, en plus des deux ailes latérales, 6 crêtes naissent entre la vésicule céphalique et la jonction oesophago-intestinale: 2 crêtes dorsales en avant de l'anneau nerveux (fig. 2 A); 2 crêtes ventrales en avant du pore excréteur chez le mâle (fig. 1 A) et en arrière de celui-ci chez la femelle (fig. 2 B) puis naissent une crête ventrale (fig. 1 B) et une crête dorsale. Chez quelques individus, ces deux dernières crêtes naissent plus postérieurement en arrière de la jonction oesophago-intestinale. On atteint le chiffre de 3 dorsales et de 3 ventrales aussi bien chez le mâle (fig. 1 C) que chez la femelle (fig. 2 C). Chez le mâle, ce chiffre reste constant jusqu'à la moitié du corps environ (fig. 2 C) puis apparaissent 2 crêtes dorsales supplémentaires (fig. 1 D) et enfin à environ 400 μm plus postérieurement, 2 crêtes ventrales ce qui correspond à un total de 5 dorsales et 5 ventrales (fig. 1 E). A environ 300 μm en avant de la bourse caudale les crêtes disparaissent progressivement sur les faces dorsale et ventrale. Il n'y a plus de crêtes à environ 80 μm en avant de la bourse caudale. Chez la femelle, 2 crêtes dorsales supplémentaires apparaissent à environ 400 μm avant le milieu du corps (fig. 2 D) puis une crête ventrale 100 μm plus postérieurement, ce qui donne 5 dorsales et 4 ventrales au milieu du corps (fig. 2 E). Ce chiffre reste constant jusqu'au niveau pré-vulvaire où, selon les spécimens, 1 à 2 crêtes ventrales supplémentaires apparaissent. A ce niveau, les ailes latérales très réduites sont légèrement décalées dorsalement (fig. 2 F). Au-delà de la vulve, les crêtes disparaissent progressivement.

Les ailes et les crêtes sont fortement orientées du ventre vers le dos dans le tiers antérieur du corps (fig. 1 B, 2 B). Cette orientation fait progressivement place à une orientation où les crêtes sont perpendiculaires à la paroi du corps.

En plus du synophe, il existe dans la région vulvaire des séries d'épines disposées longitudinalement et dont la pointe est dirigée vers l'arrière (fig. 4 C-G). L'étendue de la spinulation correspond plus ou moins à la longueur de l'ovéjecteur (de 130 à 200 μm selon les spécimens). Le nombre et la taille des épines est variable d'un spécimen à l'autre. D'environ 8 à 12 μm de haut pour la majorité d'entre elles, elles peuvent atteindre 18 μm pour les plus grandes, généralement situées près de la vulve. D'une façon générale, les ventrales sont plus grandes que les autres. Les épines sont enfouies dans l'anneau de copulation, lorsqu'il est présent (fig. 2 G, H).

Mâle holotype: long de 3500 μm et large de 55 μm dans sa partie moyenne. Vésicule céphalique haute de 38 μm (18 μm pour le capuchon) sur 30 μm de large à la jonction des deux parties. Anneau nerveux, pore excréteur et deirides situés respectivement à 150 μm , 290 μm et 250 μm de l'apex. Oesophage long de 510 μm , soit 15% de la longueur totale du corps (fig. 3 D, E).

Bourse caudale plus large que haute, de type 2-3 (fig. 3 F). Côtes 2 et 3 de longueur équivalente aux côtes 4 et 6. Côtes 5 plus longue que les côtes adjacentes. Papilles des côtes 5 plus proches de celles des 6 que des 4. Côtes 8 naissant presque à la racine de la dorsale, dessinant un arc de cercle et légèrement plus courtes que cette

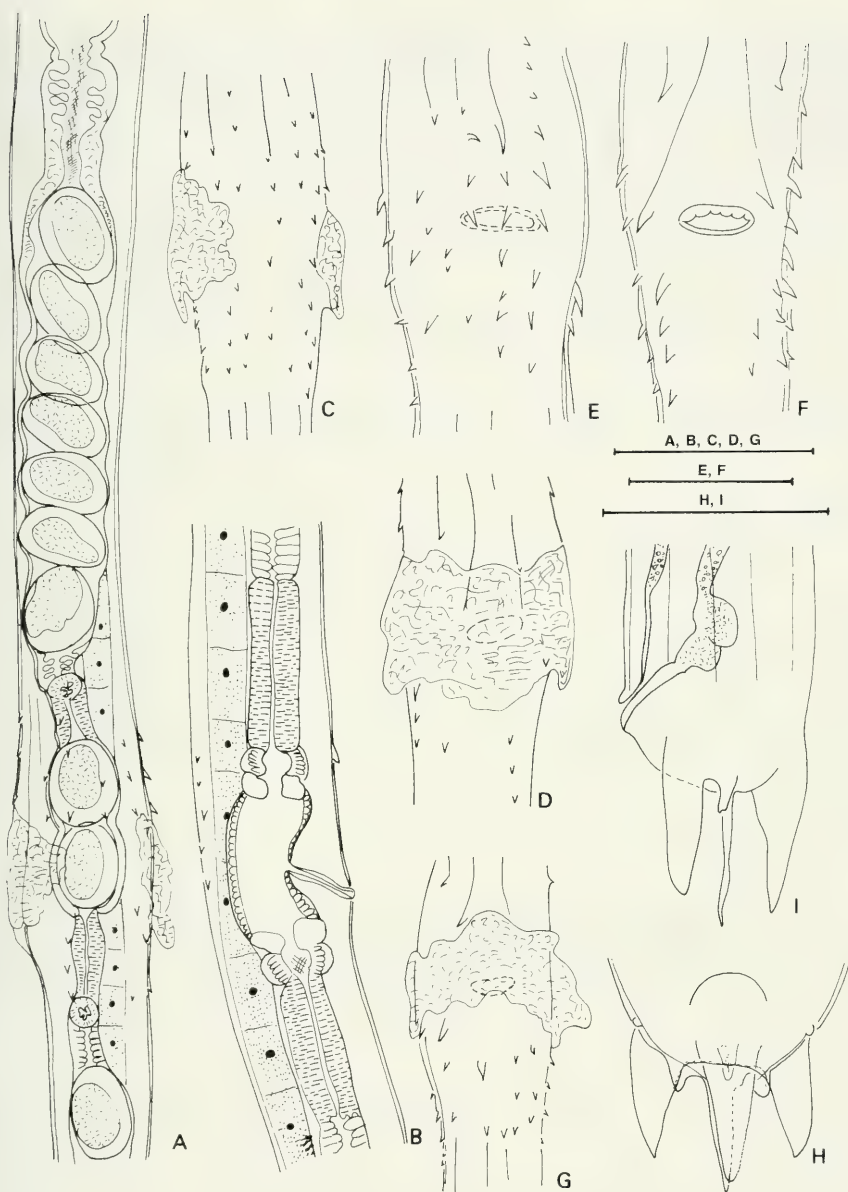


FIG. 4. *Molostrongylus acanthocolpos* n. gen. n. sp. Femelle. A - avec anneau copulateur, ovjecteur et branche utérine antérieure, vue dorsale. B - sans anneau copulateur, vue latérale droite. C à G: différents exemples de l'ornementation épineuse dans la région de l'ovjecteur. C, D: femelle paratype, vues dorsale et ventrale. E - F: femelle du lot 934 MD, vues dorsale et ventrale. G: femelle paratype, vue ventrale. H, I - queue, successivement vues ventrale et latérale gauche. Echelles: A - D, G: 150 μ m ; E, F: 100 μ m; H, I: 50 μ m.

dernière (fig. 3 J). Dorsale relativement longue, atteignant le bord de la bourse caudale. Les côtes 9 se détachent de la côte dorsale après la division de cette dernière dans sa partie distale. Côtes 10 plus longues que les côtes 9, pointues à leur extrémité (fig. 3 G). Chez quelques mâles du matériel complémentaire, nous avons observé une membrane tendue entre les deux lobes latéraux, à l'intérieur de la bourse caudale (fig. 3 J).

Spicules en forme de cône allongé, à pointe unique et non ailés, longs de 90 μm . Gubernaculum en forme de lame en vue latérale. Vu de profil, il mesure 48 μm de haut sur 2 μm de large dans sa partie moyenne. Le quart distal, sinueux, se termine par une pointe effilée. Cône génital de forme triangulaire portant, sur sa lèvre ventrale, une papille zéro bien développée et, sur sa lèvre dorsale, deux papilles 7 filiformes (fig. 3 I).

Femelle allotype: longue de 4700 μm , large de 80 μm dans sa partie moyenne et de 100 μm au niveau de la vulve. Vésicule céphalique haute de 42 μm (20 μm pour le capuchon) sur 33 μm de large à la jonction des deux parties. Anneau nerveux, pore excréteur et deirides situés respectivement à 160 μm , 400 μm et 320 μm de l'apex. Oesophage long de 550 μm soit 12 % de la longueur totale du corps.

Didelphie. La vulve s'ouvre à 1300 μm de la pointe caudale, soit au début du tiers postérieur du corps. Présence d'un anneau copulateur au niveau de la vulve interrompu sur la face dorsale (fig. 4 C, D). Cet anneau est présent chez toutes les femelles paratypes à l'exception de l'immature. Dans le matériel complémentaire, une femelle sur 2 présente cet anneau. Vagina vera dirigé vers l'avant, long de 30 μm , divisant le vestibule en deux parties de longueur équivalente. Vestibule: 65 μm ; sphincters: 22 x 32 μm ; trompe antérieure: 70 μm , postérieure: 80 μm ; branches utérines très courtes: 500 μm pour l'antérieure, 420 μm pour la postérieure soit un peu moins de 20% de la longueur totale du corps. La branche utérine antérieure contient 5 oeufs et la branche postérieure 3. Les oeufs, au stade morula sont hauts de 80 μm sur 50 μm de large (fig. 4 A, B).

Queue épaisse, courte, presque aussi large que haute (40 x 50 μm). Elle porte une épine caudale médiane longue de 31 μm , une grosse pointe dorsale, deux grosses pointes latéro-ventrales et deux tubercules latéraux. Les phasmides, en forme de boutons, sont visibles juste en avant des pointes latéro-ventrales (fig. 4 I, H).

DISCUSSION

La présence d'une tête non armée de crochets ou d'épines mais munie d'un capuchon céphalique est interprétée comme une synapomorphie groupant les parasites du *Molossops* avec le groupe constitué par *Anoplostrongylus* (*Anoplostrongylus*) Boulenger, 1926, parasite de Molossidae, *Torrestrongylus* Perez-Vigueras, 1935 parasite de Phyllostomidae et *Tricholeipeiria* Travassos, 1935, parasite de Phyllostomidae, de Noctilionidae, de Molossidae mais surtout de Natalidae. En plus de leurs caractères céphaliques, ces trois genres ont également en commun avec nos spécimens, un synlophe formé d'au moins deux crêtes latérales et possédant un axe d'orientation ventro-dorsal au moins dans la partie antérieure du corps, et une queue femelle avec un filament médian et 3 grosses pointes, une dorsale et 2 latéro-ventrales.

La forme du capuchon céphalique qui est double et non simple, le type de bourse caudale, la forme et la longueur des spicules, certains caractères du synlophe éloignent les parasites du *Molossops* des genres *Torrestrongylus* et *Tricholeipeiria*. De plus, chez ce dernier genre, le gubernaculum est absent et l'ovéjecteur de la femelle asymétrique.

Le genre le plus proche est *Anoplostrongylus* avec en particulier chez le mâle des côtes 2 et 3 de longueur identique, des côtes 8 naissant à la racine de la côte 9 et plus courtes que la côte dorsale, des côtes 9 plus courtes que les côtes 10, des spicules courts et à pointe unique et chez la femelle, un vestibule dont les branches sont de même longueur. Cependant le parasite de *Molossops* diffère d'*Anoplostrongylus* par les caractères suivants: chez le mâle, les côtes 2 et 3 sont de longueur équivalente à celles des 4 et 6 alors qu'elles sont plus développées chez *Anoplostrongylus*, la côte dorsale est longue et divisée dans son tiers distal alors qu'elle est courte et divisée très profondément chez *Anoplostrongylus*, les côtes 8 sont plus courtes que la côte dorsale, les spicules se terminent par une pointe mousse et non en hameçon; la femelle est pourvue d'épines vulvaires dans la région de l'ovejecteur, absentes chez *Anoplostrongylus*.

REMERCIEMENTS

Nous remercions le Ministère de l'Agriculture et des Elevages du Paraguay, pour les autorisations relatives au travail de terrain, nos collègues de mission, particulièrement Carlo Dlouhy (Asuncion) et le Dr. F. J. Baud (Genève) pour l'identification des hôtes.

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On some *Ancistria* spp. from the Natural History Museum, Vienna (Coleoptera, Passandridae)

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On some *Ancistria* spp. from the Natural History Museum, Vienna (Coleoptera, Passandridae). - Information is provided on a collection of *Ancistria* spp. deposited in the Natural History Museum, Vienna. *A. schuhi* sp. n. is described and illustrated based on material from Java. Characters are listed to separate it from its closest relative, *A. grouvellei*. *A. indicus* and *A. tenera*, known up to now only from their type series, are recorded from additional localities in India: Kerala and Java respectively. A specimen of *A. retusa* from Brazil confirms the presence of the species in the New World.

Key-words: Coleoptera - Passandridae - *Ancistria* - taxonomy.

INTRODUCTION

Ancistria is with 33 described species the largest genus of the cucujoid family Passandridae. It is restricted to the Old World with the exception of a single specimen of *A. retusa* (Fabricius) which may originate from Brazil. *Ancistria* is most diverse in the Indo-Australian tropics. The taxonomy of the group was revised by BURCKHARDT & SLIPINSKI (1995) who diagnosed the species and provided a key for their identification.

The present paper deals with a collection of *Ancistria* deposited in the Natural History Museum, Vienna (NHMW) which contains five known and one new species. Morphological terminology follows BURCKHARDT & SLIPINSKI (1995). Duplicates are kept in the Natural History Museum, Geneva (MHNG).

***Ancistria apicalis* Reitter**

Material examined. China: 1 specimen, Hunan, Huitong, 1992, ex larva (C. Holzschuh) (NHMW).

Previously reported from Japan, China and Vietnam (BURCKHARDT & SLIPINSKI, 1995).

***Ancistria beccarii* Grouvelle**

Material examined. Indonesia: 1 specimen, W Sumatra, 1992 (NHMW); 1 specimen, SE Sulawesi, Kendari Airport, 30 km W of Kendari, 11–14.II.1994 (M. Strba & I. Jenis) (NHMW).

Previously reported from New Guinea, Moluccas and Malaysia (BURCKHARDT & SLIPINSKI, 1995).

***Ancistria indica* Burckhardt & Slipinski**

Material examined. India: 2 specimens, Kerala, Cardamom Hills, 10 km SW Munnar Vattiar, 1000 m, 6–18.XII.1993 (Boukal & Kejval) (NHMW).

Previously known only from the type series which was reported with some doubt from India: Tamil Nadu. The new material confirms the occurrence of the species in Southern India.

***Ancistria retusa* (Fabricius)**

Material examined. Taiwan: 1 ♂, Formosa, Fuhosho (Sauter) (NHMW). S Vietnam: 5 ♂♂, 14 km SW Bao Loc, 16–29.V.1994 (Pacholatko & Dembicky) (NHMW). Indonesia: 6 ♂♂, 3 ♀♀, SE Sulawesi, Buton Island, Warkarumba, 3–7.II.1994 (M. Strba & I. Jenis) (NHMW, MHNG). Brazil: 1 ♂, without additional data (NHMW).

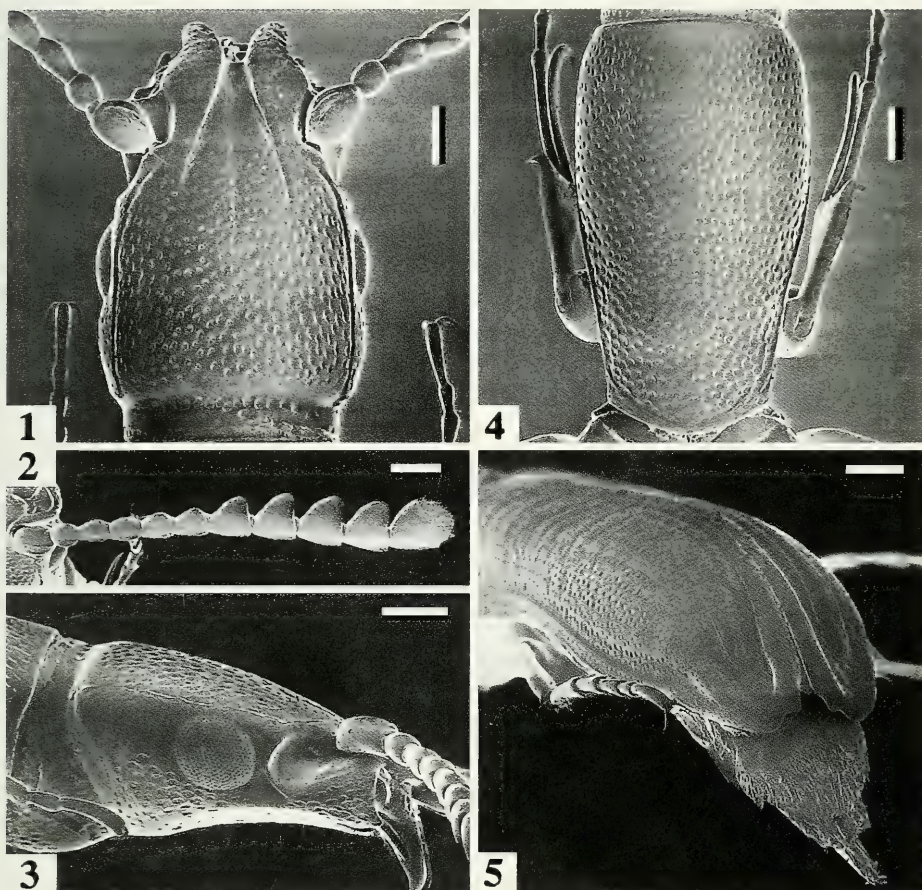
Reported from Africa, Tropical Asia, Australia and questionably from Brazil (BURCKHARDT & SLIPINSKI, 1995). The specimen from Brazil from the NHMW confirms the occurrence of the species in the New World.

***Ancistria schuhi* sp. n.**

(Figs 1–7)

Material examined: Holotype ♀, Indonesia: W Java, Puncak Pass, SE Bogor, Telaga Warna, ca. 1400 m, 1.VIII.1994 (R. Schuh) (NHMW). Paratype: 1 ♀, same data as holotype but (MHNG).

Description. Length 6.3–6.5 mm. Almost black, tarsi dark reddish brown, abdominal venter dark brown; surface shiny. Head (fig. 1) 1.4 times as long as wide; punctation slightly strigose laterally; median line present in apical half, absent from basal half; admedian lines moderately long, straight, admedian lobes narrowly triangular; lateral frontal processes flattened, anteriorly produced into a large, weakly outwards curved lobe which is evenly rounded apically; joint width of frontal processes 5.3 times that of frontoclypeal depression. Eye moderate in size (fig. 3), temple length/eye diameter ratio as 1.4. Antenna (figs 1, 2) with segment 1 bearing 2 fine, unequal dorsal grooves; segment 2 subglobular; segments 3–6 asymmetrically oval; segments 7–11 flattened, forming a distinct club; segment 11 longer than wide. Pronotum (fig. 4) 1.8 times as long as wide, not or indistinctly bordered at base, evenly widening in apical half, with subparallel margins over most of apical half, slightly narrowed apically; punctation similar to that on head, denser laterally, apico-laterally slightly strigose, basi-laterally somewhat confluent, in basal half leaving a narrow median stripe uncovered. Mesotibia about as long as first tarsomere of mid-leg. Elytra (fig. 5) 3.3 times as long as wide, 2.0 times as long as pronotum; costa 3 weakly inflated subapically, costae 4 and 6 merging apically; interval 3 long, interval

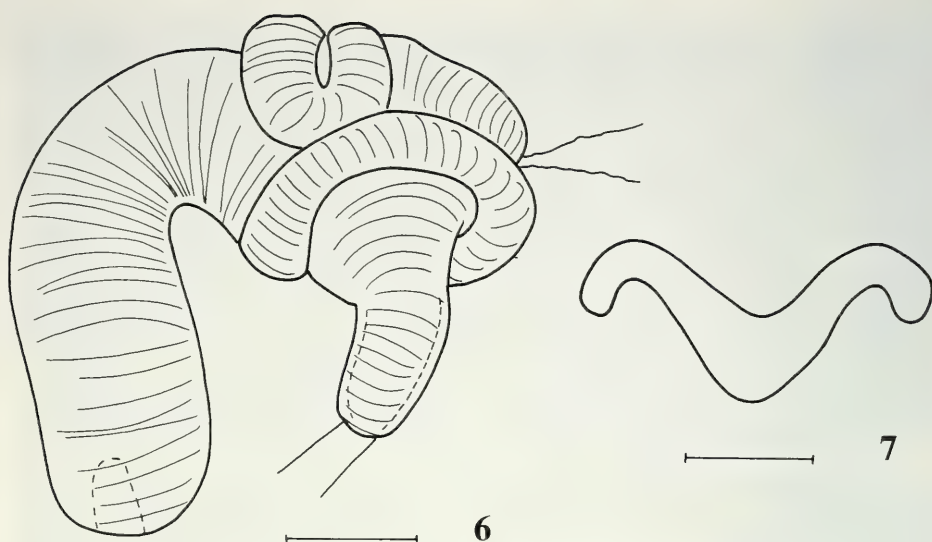


FIGS 1-5

Ancistria schuhi sp. n., ♀ holotype. 1, head, dorsal view; 2, antenna; 3, head, in profile; 4, pronotum, dorsal view; 5, elytra, oblique rear view. Scale bars = 0.2 mm.

5 short, and interval 4 intermediate; apex moderately emarginate, distinctly incised at suture, with distinct tooth. Female genitalia as in figs 6 and 7; male unknown.

Affinities. *A. schuhi* is closely related to *A. grouvellei* Burckhardt & Slipinski based on the flattened, broad, anteriorly prolonged frontal processes, in addition to the long pronotum and the tibia and basitarsus of the mid-legs which are approximately of the same length. *A. schuhi* differs from *A. grouvellei* in the larger body size, the larger anterior lobes on the frontal processes, the more emarginate elytral apex and the more convoluted spermatheca.



FIGS 6-7

Ancistria schuhi sp. n., ♀ paratype. 6, spermatheca; 7, ostium bursae. Scale bars = 0.1 mm.

***Ancistria tenera* Günther**

Material examined. Indonesia: 2 ♂♂, W Java, Puncak Pass, SE Bogor, Telaga Warna, ca. 1400 m, 1.VIII.1994 (R. Schuh) (NHMW, MHNG).

Previously known only from the ♂ holotype from W Java (Heller & Günther, 1936).

ACKNOWLEDGMENTS

I thank R. Schuh and H. Schillhammer (NHMW) for the loan of the material, J. Wüest (MHNG) for the preparation of the SEM-pictures, G. Roth (MHNG) for inking the drawings and A. Reversy (Geneva) for technical assistance.

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A review of the Japanese *Tychobythinus* and *Bythoxenites* (Coleoptera, Staphylinidae, Pselaphinae)

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A review of the Japanese *Tychobythinus* and *Bythoxenites* (Coleoptera, Staphylinidae, Pselaphinae). – *Tychobythinus* is represented in Japan by 3 species, with *T. japonicus*, described as new. *Bythoxenites* holds 10 species and is widely distributed in Japan. The group is defined by the presence of a single pair of foveae at the base of the 4th abdominal ventrite and of an internal aedeagal ridge. The type species of *Bythoxenites*, *B. japonicus*, is known from a cave, but most species inhabit moist forest floor litter. Eight new species of *Bythoxenites* are described: *B. longicornis*, *B. torticornis*, *B. diversicornis*, *B. pubiceps*, *B. brevicornis*, *B. brevipilis*, *B. breviceps* and *B. frontalis*. Keys to Japanese genera of Bythinini and to Japanese species of *Tychobythinus* and *Bythoxenites* are provided.

Key-words: Coleoptera - Staphylinidae - Pselaphinae - Bythinini - taxonomy - Japan.

INTRODUCTION

The last and most complete account of the Japanese Bythinini is by JEANNEL (1958). He treated two genera, the monobasic *Bythoxenites* Jeannel and the widely distributed *Bryaxis* Kugelann with 14 species in Japan. Since, NOMURA (1995) described an additional Japanese species of *Bryaxis*, *B. kintaro*. Thus, the knowledge of the Japanese Bythinini appears inadequate, compared to that of the Taiwanese (LÖBL & KURBATOV, 1995; 1996) or Far East Russian Bythinini (KURBATOV, 1994).

A large amount of additional material of Bythinini has since been collected in Japan. It consists mainly of numerous species of *Bryaxis*, however, a number of specimens belonging to *Tychobythinus* Ganglbauer and *Bythoxenites* have been found also and are treated in the present paper.

MATERIAL AND METHODS

The material examined is deposited in the Muséum d'histoire naturelle, Geneva (MHNG), except for several paratypes of *Bythoxenites brevicornis*, *B. diversicornis* and *B. frontalis* which are also in the private collection of the junior author (CSKM).

The measurements are taken as follows: total length from the anterior clypeal edge to the abdominal apex; length of the head from the anterior clypeal edge to the dorsal transverse ridge of the neck when the neck is exposed, or to the edge of the neck constriction when the base of the neck is concealed in dorsal view; width of the frons, the head, the pronotum, the elytra, the antennal and palpal segments the widest point; length of the scape in dorsal view, from the apical edge of the dorsobasal impression to the apical margin; length of the antennal segments 2 to 11 without the basal stalks. The pubescence refers to that on the head and body.

The aedeagi have been mounted in Canada balsam on acetate slides and are illustrated using a drawing tube on a compound microscope. The fine structures of the internal sac and the paramere sensilla have been examined using Nomarski interference contrast optics.

TAXONOMY

KEY TO THE JAPANESE GENERA OF BYTHININI

- 1 Abdominal ventrite 4 (2nd exposed) with a pair of laterobasal foveae, lacking a pair of mediobasal foveae. Median lobe of aedeagus with sclerotised internal mediodorsal ridge *Bythoxenites*
- Abdominal ventrite 4 (2nd exposed) with two pairs of basal foveae, the inner pair of foveae connected by a transverse bridge. Median lobe of aedeagus without internal mediodorsal ridge 2
- 2 Scape with an entire, distinct dorsobasal ridge *Bryaxis*
- Scape without, or with incomplete dorsobasal ridge *Tychobythinus*

Tychobythinus Ganglbauer

Three species of *Tychobythinus* are represented within the collections examined, but only one of them is known from the male sex. It is a new species, described below. The other two species are likely new but as each is known in a single female, we find preferable not to name and describe them. Presently, the members of *Tychobythinus* appear to be found sporadically in eastern Asia, with three species occurring in Japan, one in the Kurile archipelago, one in Sichuan, one in Taiwan and one in northern Thailand (LÖBL & KURBATOV, 1995).

KEY TO THE JAPANESE *Tychobythinus*

- 1 Frons not impressed between antennal tubercles. Vertex with distinct tentorial pits. Pronotal punctation fine *T. japonicus*
- Frons impressed between antennal tubercles. Dorsal tentorial pits absent. Pronotal punctation coarse 2
- 2 Maxillary palpi with segment 3 short, slightly longer than wide . . *T. species A*
- Maxillary palpi with segment 3 elongate, about 3 times as long as wide *T. species B*

***Tychobythinus japonicus* sp. n.**

Holotype ♂: Japan, Gifu pref., 9 km E Gero, 470 m, 31.VII.1980, leg. I. Löbl (nr 24); sifted leaf litter and wood on a steep slope in a ravine, near a stream (MHNG).

Length 1.20 mm. Body and appendages uniformly light ochreous. Pubescence semi-erect, long, that on abdomen recumbent.

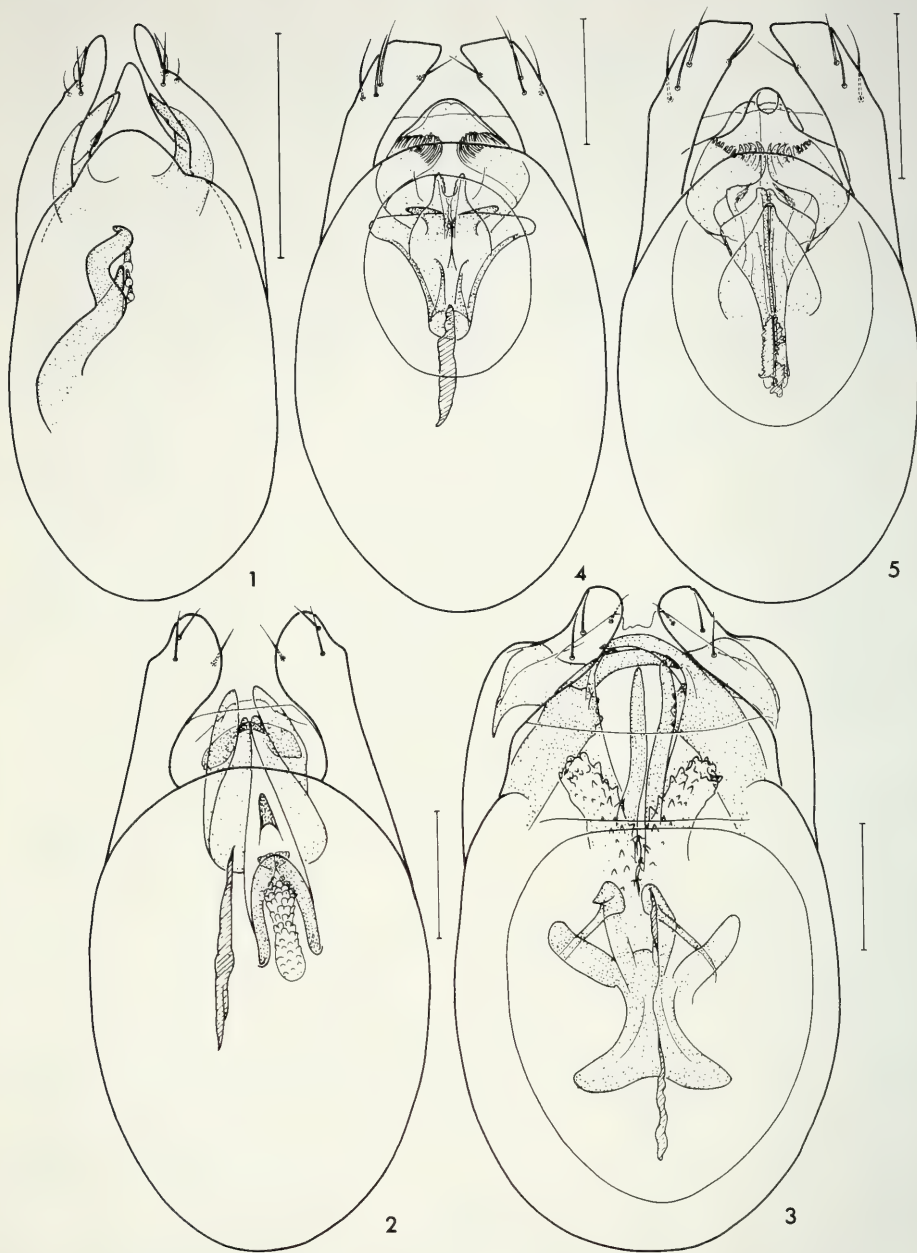
Head 0.25 mm long, 0.24 mm wide. Punctuation coarse and very dense, not confluent, puncture intervals consisting mostly of very narrow ridges, larger on posterior portion of vertex. Most punctures about as large as facets. Frons with four conspicuously large impressed punctures arranged in a rectangle, each bearing a conspicuous, widened seta. Pubescence orientated anteriorly on anterior portion of frons, obliquely mesally on lateral portions of vertex, apically on median portion of vertex. Frons narrow, hardly narrowed posterior to antennal tubercles, widened irregularly toward eyes, with anterior edge distinctly angulate, lateral edges slightly angulate anterior to eyes. Frontal impression absent. Frontoclypeus almost vertical, not projecting below, with clypeal margin convex. Vertex convexly raised. Dorsal tentorial pits situated each in a shallow impression in level of anterior eye margin, small, about as large as surrounding punctures. Interval between tentorial pits almost 10 times as large as diameter of one tentorial pit. Vertex and occiput without median carina. Eyes small, flat, with 6 facets. Maxillary palpi with 2nd segment 0.15 mm long, gradually thickened apically, at apex 0.03 mm wide, tuberculate ventrally; 3rd segment 0.04 mm long, slightly longer than wide, as wide as 2nd segment, bearing a few ventral tubercles; 4th segment stout, 0.18 mm long, 0.06 mm wide.

Antennae fairly short. Scape straight, 0.07 mm long, 0.05 mm wide, cylindrical, not narrowed subbasally in dorsal view; dorsobasal ridge absent, except near lateral edges. Pedicel asymmetrical, about as wide as scape, slightly wider than long. Segments 3 to 10 symmetrical. Segment 3 almost as long as wide. Segments 4 to 8 evenly large, shorter than, and as wide as segment 3, about as long as half of length of pedicel. Segment 9 as long as 8 but wider, almost as wide as pedicel and about 2 times as wide as long. Segment 10 longer and wider than 9, almost 2 times as wide as long. Segment 11 slightly asymmetrical, much longer than scape, about 1.4 times as long as wide, slightly longer than segments 7 to 10 combined.

Pronotum 0.33 mm long, 0.25 mm wide. Punctuation very fine and sparse, discal punctures not clearly delimited, mostly much smaller than intervals between them, punctuation between antebasal sulcus and base fairly coarse and dense, punctures much larger than intervals between them. Discal pubescence longer than that on head, orientated mesally on lateral areas, and orientated apically on median portion; pubescence near base short, orientated anteriorly. Antebasal sulcus deep, fairly wide, with sharp posterior edge. Lateral fovea situated in a large depression.

Elytra 0.44 mm long, combined 0.53 mm wide. Punctuation fine and fairly dense, punctures well delimited, intervals between punctures 3 to 4 times larger than their diameters. Humeral area rounded, slightly raised. Marginal carina visible in dorsal view, touching subhumeral fovea from below.

Metathoracic wings not examined.



FIGS 1-5

Aedeagi in *Tychobythinus* and *Bythoxenites*; 1. *T. japonicus*; 2. *B. longicornis*; 3. *B. brevicornis*; 4. *B. torticornis*; 5. *B. diversicornis*. Scale bars = 0.1 mm.

Metasternum and abdominal sternites evenly very finely punctate; punctuation on median portion of metasternum denser than that on lateral portions of metasternum.

Protibiae straight. Mesotibiae straight, flattened apically. Metatibiae gradually stouter toward apical third, curved and flattened in apical fourth.

Male sexual characters: Frons, vertex, and appendages apparently lacking sexual characters. Head swollen ventrally, anterior to level of eyes, to form a transverse ridge separated from mouthparts by a narrow and shallow impression. Transverse ridge punctate and pubescent ventrally, with posterior surface strongly inflexed and glabrous. Aedeagus (Fig. 1) 0.25 mm long. Parameres abruptly narrowed apically, each with one wide and two slender, hair-like sensilla. Internal sac bearing a pair of apical, symmetrical, curved sclerites and an asymmetrically sinuous median sclerite bearing a ventral apophyse, accompanied by three minute teeth-like sclerites.

Comments. This species shares with *T. aino* Kurbatov the abruptly narrowed apical portion of the parameres. It differs however drastically by the shape of the sclerites of the internal sac of the aedeagus. Externally, it resembles *T. siamensis* from which it may be readily distinguished by the tuberculate 2nd and 3rd segment of the maxillary palpi.

***Tychobythinus* sp. A**

Material: 1 ♀, Japan, Honshu, Gifu pref., 8 km SE Gero, 500 m, 31.VII.1980, leg. I. Löbl (MHNG), in sifted deep layer of rotten wood and leaves on a slope, near a stream.

Comments. This species may be distinguished from other East and Southeast Asian species of *Tychobythinus*, except species B, by the head coarsely and densely punctate, and lack of dorsal tentorial pits. In general appearance it resembles *T. siamensis* Löbl & Kurbatov, but may be easily distinguished by the much lighter body and the conspicuously tuberculate 2nd and 3rd segments of the maxillary palps. *Tychobythinus siamensis* possesses maxillary palpi with segment 3 much shorter than that in species B.

***Tychobythinus* sp. B**

Material: 1 ♀, Japan, Shikoku, Ehime pref., Ishizuchi Nat. Park, Omogo, 12.VIII.1980, leg. C. Besuchet (MHNG).

Comments. This species may be distinguished readily from other Asian species of *Tychobythinus* by the elongate 3rd segment of the maxillary palpi, the scape narrowed subbasally, the pronotal punctures variably large, with edges distinctly raised, and lacking dorsal tentorial pits.

***Bythoxenites* Jeannel**

YOSHIDA & NOMURA (1952) described *Machaerites* (*Bythoxenus*) *japonica* from a limestone cave in Japan, Okutama province, Honsyu. It has been found «allied to *M. (Bythoxenus) Revelieri* Reitter», an European species endemic to Corsica, placed by JEANNEL (1950) in his *Amaurobythus* which is synonym of *Tychobythinus*

(BESUCHET, 1974). According to the description and illustration, *M. japonica* is characterised by the combination of following features: 1) head rugosely punctate; 2) antennae with scape long, about as long as one fourth body length; 3) maxillary palpi with segment 2 tuberculate except at base; 4) segment 4 of the maxillary palpi large, tapering; 5) elytra conspicuously long and gradually widened apically. Jeannel (1958) based his new genus *Bythoxenites* on the description of *Machaerites* (*Bythoxenus*) *japonica*. According to him, this genus differs from the Slovenian *Machaerites* Miller (and, implicitly from *Bythoxenus* Motschulsky) by «numerous characters», particularly the rugosely punctate head.

Nine species exhibit the characters of *Bythoxenites* within the examined collections. In addition, they share an unique aedeagal feature, a sclerified dorsomedian ridge situated below the compression plate of the median lobe. This ridge is not attached to the internal sac, as seen in one specimen which has the internal sac completely extruded. Thus, *Bythoxenites* appears to be one of the few Bythinini genera defined by a robust autapomorphy. Unlike in *Bryaxis* and *Tychobythinus*, the 4th (2nd exposed) abdominal sternite in *Bythoxenites* lacks internal sclerotised structures, the pair of the mediobasal foveae and the basal grooves.

We have not been able to see the type material of *Bythoxenites japonicus* (Yoshida & Nomura), and cannot supplement its description which is lacking in some critical details. The species of *Bythoxenites* we have examined vary in numerous characters, in particular in the size of the antennal and palpal segments. They are notably smaller than *B. japonicus* (which is according to the description 2.2 mm long), and none of them have the maxillary palpi as figured in that species. Thus, we do not hesitate to consider them as new.

YOSHIDA & NOMURA (1952) believed *Bythoxenites japonicus* to be microphthalmous, and compared it to European anophthalmous taxa known to inhabit caves and soil. However, the eyes in male *Bythoxenites* are not reduced. The males have distinct humeral angles which indicate the presence of functional metathoracic wings. In large-eyed males of *B. diversicornis*, *B. frontalis*, and *B. longiceps*, the metathoracic wings are well developed while in females of *B. brevicornis*, *B. diversicornis* and *B. frontalis*, they are absent. The presence of the metathoracic wings has not been examined in the remaining species which are represented by one or two specimens only.

Like in many other Bythinini, the species of *Bythoxenites* exhibit secondary sexual characters on the gular area, the tibiae, and have larger eyes and longer elytra with more distinct humeral angles in males than in females. More unusual are the sexually modified frons and vertex, the tuberculate profemora in males of some species, and the prothorax which are more or less distinctly angulate in males. The antennae are usually similar in both sexes, but the 4th antennal segment is enlarged in male of *B. torticornis* and *B. diversicornis*.

Bythoxenites is similar to *Tychobythinus* and unlike *Bryaxis*, in having the dorsobasal scapal ridge more or less reduced, and the elytral bases not raised. Its relationships are unknown as no attempt has yet been made to analyse the relationships within the Bythinini. Also, the key to the Palaearctic Bythinini genera (BESUCHET, 1974) is inapplicable to *Bythoxenites*.

KEY TO THE SPECIES OF *Bythoxenites*

- 1 Length 2.20 mm *B. japonicus*
- Length 1.55–2.05 mm 2
- 2 Elytral pubescence conspicuously short and recumbent, similar to that on abdomen *B. brevipilis*
- Elytral pubescence not conspicuously short, semi-erect or erect, usually longer than that on abdomen 3
- 3 Punctuation on pronotal centre conspicuously coarser than that on lateral pronotal area *B. brevicornis*
- Pronotum with centre as finely punctate, or centre slightly coarser punctate than lateral portions 4
- 4 Frontoclypeus bearing sparse setae orientated anteriorly or gradually curved ventrally 5
- Frontoclypeus with dense pubescence orientated ventrally 9
- 5 Antenna with segment 9 elongate 6
- Antennae with segments 9 as long as wide, or wider than long 7
- 6 Vertex raised, with short median carina and distinct tentorial pits *B. longicornis*
- Vertex flattened, with long median carina and obsolete tentorial pits species A
- 7 Antennal segment 4 unmodified and symmetrical in male *B. frontalis*
- Antennal segment 4 modified and asymmetrical in male 8
- 8 Male with outer apical angle of antennal segment 4 not prominent. Aedeagus with apical laminae of internal sac ending by a row of evenly narrow denticles *B. torticornis*
- Male with outer apical angle of 4 antennal segment prominent. Aedeagus with apical laminae of internal sac ending by denticles becoming larger toward mid-line *B. diversicornis*
- 9 Antennal segments 9 and 10 each longer than wide *B. longiceps*
- Antennal segments 9 and 10 each shorter than wide *B. pubiceps*

***Bythoxenites longicornis* sp. n.**

Holotype ♂: Japan, Shikoku, Ehime pref., Ishizuchi Mt. Nat. Park, Tsuchigoya, 1400 m, 11–18.VIII.1980, leg. S. & J. Peck, malaise trap-trough *Fagus-Abies* forest (MHNG).

Length 2.0 mm. Body reddish-brown, appendices lighter. Pubescence fairly long, erect on head and pronotum, semi-erect on elytra, almost recumbent on abdomen.

Head 0.40 mm long, with eyes 0.40 mm wide, frons 0.25 mm wide anteriorly. Frontal impression wide and deep, distinctly, irregularly punctate anteriorly, impunctate posteriorly. Antennal tubercles raised, smooth, each narrower than frontal impression. Anterior edge of frons sharply delimited, angular. Frontoclypeus vertical and rounded below, with long setae orientated anteriorly. Frons distinctly narrowed posterior to antennal tubercles, then gradually widened toward eyes. Dorsal edges of genae straight and sharp. Vertex slightly convex. Dorsal tentorial pits inconspicuous,

situated slightly posterior of level of anterior eye margin, much closer to dorsal eye margin than to vertexal mid-line. Vertexal sulci inconspicuous, very shallow and narrow, traceable from tentorial pits to frontal impression. Anterior portion of vertex abruptly delimited by a smooth area obliquely inflexed toward frontal impression. Vertex with high mesal carina starting at level of tentorial pits and ending on inflexed, smooth area. Vertexal punctation coarse and very dense, punctures deep, mostly larger than facets, separated by narrow ridges. Eyes large, convex, prominent, with numerous facets, slightly longer than tempora (lateral view). Tempora rounded. Neck concealed in dorsal view.

Postgenae oblique and strongly inflexed between neck and gular groove, bearing long erect setae curved anteriorly. Gular groove transverse, deep, with sharp anterior and obtuse posterior edges. Posterior edge prominent in middle and bearing two fairly long, horizontal, divergent tufts of setae; anterior edge with two very short, vertical laminae. Area between gular groove and mouthparts impressed, with a low median ridge.

Maxillary palpi with 2nd segment tuberculate; 3rd segment tuberculate apically; 4th segment large, 0.39 mm long, 4 times longer than wide, with concave outer edge.

Antennae long. Scape subcylindrical, in dorsal view straight, about 3 times as long as wide, widest near apex, from widest point gradually narrowed basally and strongly narrowed apically. Scape slightly curved. Pedicel subcylindrical, slightly narrowed basally, in length slightly exceeding width of scape, 1.6–1.7 times as long as wide. Dorsobasal scapal ridge indistinct in middle. Segments 3 to 8 evenly wide, about as wide as two thirds of pedicel. Segment 3 as long as pedicel, 2.5 times as long as wide, narrowed basally. Segments 4 and 5 each shorter than pedicel, evenly long and wide, each about 2 times as long as wide. Segments 6 and 8 shorter than segment 5, evenly long and wide, each about 1.5 times as long as wide. Segment 7 longer than 6 (or 8), slightly shorter than 3, about 2 times as long as wide. Segment 9 and 10 evenly long, each slightly longer than pedicel, 9 about 1.7 times as long as wide, 10 thicker, 1.3 times as long as wide. Segment 11 somewhat longer than 9 and 10 combined, distinctly shorter than scape, 2.5 times as long as wide.

Pronotum 0.46 mm long, 0.50 mm wide. Antebasal sulcus sinuate, not well delimited, widened in middle. Punctation coarse and very dense, irregular, partly confluent between antebasal sulcus and basal edge; intervals between punctures formed by narrow ridges. Punctation fairly dense and very fine on most of area between antebasal sulcus and anterior pronotal edge, with punctures several times smaller than intervals; punctation distinctly denser near anterior edge than middle of disc.

Elytra 0.84 mm long, combined 0.79 mm wide, gradually widened apically, almost regularly vaulted dorsally. Basal foveae deep, well delimited, their diameters slightly smaller than intervals between them. Humeral hump low, elongate. Discal punctation very fine and sparse.

Profemora lacking tubercles. Protibiae straight, gradually stouter toward apical fourth, with a deep subapical notch and sharp denticle. Mesotibiae becoming moderately, gradually stouter toward apical third, rather abruptly curved just before

apical third, almost evenly thick in apical third. Metatibiae almost evenly thick, straight in basal half, slightly curved in apical half, with an apical denticle.

Aedeagus (Fig. 2) 0.505 mm long. Parameres widened and rounded apically, with outer edges angulate subapically; each bearing 3 hair-like sensilla. Internal sac with a pair of symmetrical basal sclerites, a mediobasal vesicle, median denticle and large apical laminae.

Comments. This species may be readily distinguished by the notably elongate antennae, in combination with the raised vertex.

Bythoxenites brevicornis sp. n.

Holotype ♂: Japan, Ehime pref., Mt. Ishizuchi Nat. Park, steep ravin near Skyline Road, 1000 m, 14.VIII.1980, leaf litter and rotten wood, leg. I. Löbl (MHNG).

Paratypes: 3 ♀, Japan, Ehime pref., Mt. Ishizuchi National Park, Omogo Valley, 700 m, 18–25.VIII.1980, S. & J. Peck, moss, fungi & log litter, warm temp. forest (MHNG, CSKM); 1 ♀, same data but Tsuchigoya 1400 m, 16.VIII., log & moss litter (MHNG).

Similar to *B. longicornis* from which it differs as follows:

Length 1.80–1.85 mm. Head, pronotum and elytra dark reddish-brown, abdomen, antennae, palpi, femora and tibiae lighter, tarsi yellow. Pronotal pubescence semi-erect.

Head 0.37–0.40 mm long, with eyes 0.35–0.37 mm wide; frons 0.21–0.23 mm wide; anterior portion of frontal impression coarsely punctate; mesal vertexal ridge lower and longer, hardly extending on anterior inflexed area. Vertexal sulci more distinct. Eyes in ♀ with 11 or 12 facets. Tempora oblique. Segment 4 of maxillary palpi 0.35 mm long, 3 times as long as wide, with straight outer margin. Prominent middle portion of posterior edge of gular groove bearing long horizontal setae divergent anteriorly.

Antennae shorter than those in *B. longicornis*. Scape slightly more than 2 times as long as wide, widest near base, slightly narrowed toward apex; straight in dorsal view, flattened dorsoventrally, with almost flat ventral side. Dorsobasal scapal ridge complete and distinct. Pedicel subcylindrical, 1.4 times as long as wide, as long as scape wide. Segments 3 to 8 evenly wide, as wide as 4/5 of width of pedicel. Segment 3 slightly shorter than pedicel, 1.5 times as long as wide, gradually widened apically. Segments 4 to 6 gradually shorter, 4 and 5 distinctly longer than wide, 6 to 8 evenly long, each about as long as wide. Segments 9 and 10 each as long as segment 3; 9 longer than wide, 10 as long as wide. Segments 11 about as long as segments 8 to 10 combined, 2.2 times longer than wide, hardly shorter and wider than scape.

Pronotum 0.38–0.43 mm long, 0.42–0.46 mm wide; discal punctation strongly irregular; punctures on central area coarse, about as large as those on vertex, regularly round, well delimited, partly larger than intervals between them; discal punctation becoming denser and slightly finer toward anterior edge, much finer toward lateral edges.

Elytra 0.71–0.74 mm long, combined 0.73–0.76 mm wide; diameters of basal foveae as large as intervals between them.

Profemora tuberculate. Mesotibiae straight.

Aedeagus (Fig. 3) 0.54 mm long. Parameres narrowed and rounded apically, with outer edges concave; each bearing 3 hair-like sensilla. Internal sac with X-shaped basal sclerites, two central vesicae, two slender medioapical sclerites, and two large tooth-like apical sclerites.

***Bythoxenites torticornis* sp. n.**

Holotype ♂: Japan, Toyama pref., Arimine, Kaminikawa 1100 m, 29.VII.1980, leg. A. Smetana (MHNG).

Paratype ♂: same data but 1150 m, leg. I. Löbl, bamboo and oak leaf litter at foot of an old oak (MHNG).

Length 1.65–1.70 mm. Head and body uniform reddish-brown, appendages slightly lighter. Pubescence long, semi-erect on head, pronotum and elytra, recumbent on abdomen.

Head 0.36 mm long, as long as wide with eyes; frons 0.18 mm wide anteriorly. Frontal impression wide, deep, coarsely and densely punctate. Antennal tubercles raised, smooth, each slightly narrower than frontal impression. Anterior edge of frons sharply delimited, subangular. Frontoclypeus strongly inflexed and rounded below, with long setae orientated anteriorly. Frons hardly narrowed posterior to antennal tubercles, then strongly widened toward eyes. Dorsal edge of genae sharp, slightly arcuate. Vertex raised. Dorsal tentorial pits conspicuous, situated slightly posterior to level of anterior eye margin, at mid-distance of eye margin and mid-line of vertex. Vertexal sulci deep, smooth, converging toward frontal impression. Vertex with short and low median carina. Vertexal punctation coarse and dense, punctures mostly larger than facets, separated by narrow ridges. Eyes large, convex, prominent, with numerous facets, distinctly longer than tempora in lateral view. Tempora rounded. Neck exposed in dorsal view, wrinkled longitudinally.

Gular area similar to that in *B. longicornis* but impressed area between gular groove and mouthparts lacking median ridge, posteriolateral portion of gular groove not clearly delimited, median portion of postgenae vaulted, bearing long, horizontal, divergent setae.

Maxillary palpi with 2nd segment bearing few inconspicuous, low tubercles on ventral side of apical portion; 3rd segment wider than long, tuberculate; 4th segment relatively small, 0.27–0.29 mm long, 3 times as long as wide, with slightly convex outer margin.

Antennae relatively short. Scape about 2 times as long as wide, subcylindrical, narrowed at base and near apex, slightly flattened ventrally, slightly curved in dorsal view; dorsobasal ridge indistinct in middle. Pedicel as long as scape wide, hardly longer than wide, suboval, more narrowed apically than basally. Segment 3 asymmetrical, slender, slightly curved, gradually stouter apically, slightly longer than pedicel, almost 2 times as long as wide. Segment 4 large, as long as pedicel, thicker than segment 3, about 1.4 times as long as wide. Segments 5 to 8 evenly large, each slightly wider than long and about as wide as segment 3. Segment 9 distinctly smaller than pedicel, slightly wider than long and slightly wider than segment 4. Segment 10

almost as long as pedicel, 1.3 times as long as 9, distinctly wider than long. Segment 11 about as long as segments 8 to 10 combined, longer than scape, about 2 times as long as wide.

Pronotum 0.36–0.37 mm long, 0.43–0.44 mm wide. Antebasal sulcus well delimited, sinuate laterally, angulate and forming a minute notch in middle. Punctuation coarse and dense, partly confluent between antebasal sulcus and basal edge; intervals between punctures variably large, many reduced to narrow ridges. Punctuation fine or very fine on area between antebasal sulcus and anterior pronotal edge, formed by shallow, not well delimited punctures becoming much more dense anteriorly.

Elytra 0.70 mm long, combined 0.71–0.72 mm wide, widest anterior to apical fifth, with lateral edges arcuate. Basal foveae deep, well delimited, smaller than interval between them. Humeral hump low, elongate. Discal punctuation very fine and sparse, punctures situated in centres of minute discs.

Profemora lacking tubercles. Protibiae slightly curved, gradually stouter toward apical fourth, notched and with denticle just before apical fourth. Mesotibiae slightly curved, with inner edge almost straight, outer edge arcuate, gradually stouter toward apical third, then narrowed. Metatibiae in basal two thirds straight and gradually stouter, then curved and evenly thick, with apical denticle.

Aedeagus (Fig. 4) 0.43 mm long. Parameres slightly widened apically, truncate at apex. Each paramere bearing 4 hair-like sensilla. Internal sac with a wide T-shaped basal sclerite, two small, curved central sclerites, two central vesicae, and two curved, weakly sclerotised apical laminae ending by densely denticulate structure.

Comments. This species may be easily distinguished from other species, *B. diversicornis* excepted, by the enlarged 4th antennal segment. It may be separated from *B. diversicornis* by characters given in the key.

***Bythoxenites diversicornis* sp. n.**

Holotype ♂: Japan, Gunma pref., E Usui Pass, 850 m, 24.VII.1980, leg. I. Löbl (nr 19a) deep layers of very moist leaf litter in a ravine (MHNG).

Paratypes: 1 ♂, 2 ♀, as holotype; 1 ♂, 2 ♀ with same data but 900 m, 25.VII. (nr 20b) leaf litter along a log (MHNG, CSKM); 1 ♀, same data but 700 m, 20.VII., leg. A. & Z. Smetana (MHNG).

Similar to *B. torticornis*, from which it differs as follows: Length 1.55–1.65 mm. Head 0.33–0.35 mm long, in ♂ 0.39 mm wide, in ♀ 0.35 mm wide. Median carina of vertex low, extending anteriorly over frontal impression, and ending at level of dorsal tentorial pits in ♂. Median carina of vertex absent from ♀. Eyes in ♀ relatively large, with 11 or 12 facets (♀ unknown in *B. torticornis*). Maxillary palpi with 3rd segment slightly longer than wide; 4th segment 0.28–0.30 mm long, about 3.2 times as long as wide. Scape almost straight in dorsal view. Antennae with pedicel longer than wide; segment 4 with prominent inner apical angle; segment 9 slightly wider than long or as wide as long. Pronotum 0.37–0.40 mm long, 0.40–0.42 mm wide. Antebasal pronotal sulcus widened and angulate in middle, not forming a notch. Elytra 0.70–0.71 mm long in ♂, 0.60–0.65 mm long in ♀, combined 0.67–0.72 mm wide.

Aedeagus (Fig. 5) 0.35–0.37 mm long. Parameres almost evenly wide, with slightly concave inner edge, subangulate outer edge, truncate apically. Each paramere bearing 4 hair-like sensilla. Basal sclerite narrower than in *B. torticornis*; apical sclerotised laminae wider, ending by a row of denticles becoming larger toward mid-line.

***Bythoxenites brevipilis* sp. n.**

Holotype ♂: Japan, Ôyamazuki, Kyoto-Fu, 18.V.1967, K. Sawada (MHNG).

Paratype ♀: same data but 20.V. (MHNG).

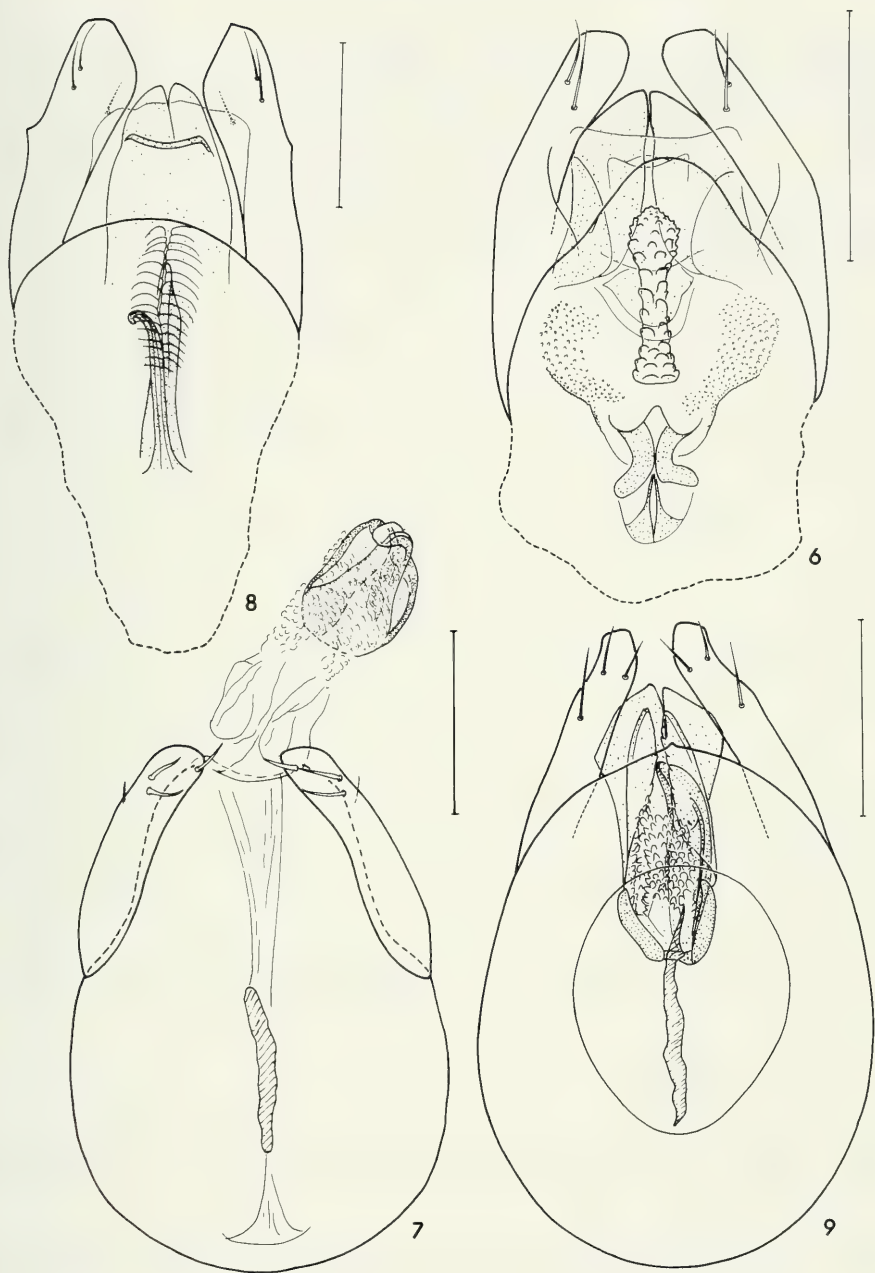
Length 1.55–1.60 mm. Head and body pale reddish-brown, partly translucent. Appendages lighter, scape not as light as remaining antennal segments. Pubescence short and recumbent on elytra and abdomen, longer on head and pronotum.

Head 0.35 mm long, with eyes 0.34 mm wide in ♂, or 0.31 mm wide in ♀; frons 0.15–0.16 mm wide anteriorly. Frontal impression deep and wide, coarsely punctate anteriorly, impunctate posteriorly. Antennal tubercles raised, smooth, each somewhat narrower than frontal impression. Frons anteriorly inflexed, without well delimited anterior edge; frontoclypeus obliquely inflexed, rounded below, with long setae orientated anteriorly. Frons distinctly narrowed posterior to antennal tubercles, then widened toward eyes. Dorsal genal edge sharp, slightly concave or straight. Vertex convexly vaulted. Dorsal tentorial pits distinct, situated in level of anterior eye margin (♂) or in front of level of anterior facets (♀), about at mid-distance between eye margin and mid-line of vertex. Vertexal sulci shallow but distinct, moderately converging toward frontal impression. Anterior portion of vertex delimited in middle by a transverse ridge, and abruptly inflexed, with a pair of setae arising from minute socles (♂), or gradually inflexed and without setae arising from socles. Vertex with mesal carina low but distinct, starting well posterior to tentorial pits, from level of posterior eye margin in ♂, posterior to that level in ♀, extending to inferior posterior edge of frontal impression in ♂, to upper posterior edge of frontal impression in ♀. Most of vertex coarsely and very densely punctate, punctures deep, about as large as facets, separated by ridges or narrow flat intervals. Central portion of vertex and areas near eyes very finely punctate. Eyes in ♂ moderately large, prominent, with numerous facets, much shorter than tempora (lateral view). Eyes in ♀ reduced, with 3 to 5 facets. Tempora slightly rounded. Neck concealed in dorsal view.

Postgenae oblique, moderately inflexed between neck and gular groove, bearing long erect setae. Gular groove similar as in *B. longicornis*; median ridge between gular groove and mouthparts absent.

Maxillary palpi with 2nd segment conspicuously tuberculate, except on basal portion; 3rd segment about as long as wide; 4th segment 0.36–0.37 mm long, 4.2–4.6 times as long as wide, with outer margin slightly concave, at apex slightly inflexed ventrally.

Antennae long. Scape slightly curved, subcylindrical, about 4 times as long as wide in dorsal view, evenly wide in posterior 3/4, narrowed basally, with ventral side flattened. Dorsobasal scapal ridge widely interrupted in middle. Pedicel cylindrical, in



FIGS 6-9

Aedeagi in *Bythoxenites*; 6. *B. brevipilis* (basal portion of median lobe deformed); 7. *B. pubiceps* (internal sac extruded); 8. *B. longiceps* (basal portion of median lobe deformed); 9. *B. frontalis*. Scale bars = 0.1 mm.

length exceeding width of scape, almost 1.7 times as long as wide. Segments 3 to 8 elongate, subcylindrical or cylindrical, evenly wide. Segment 3 almost 1.7 times as long as wide, as long as $2/3$ of pedicel. Segments 4 and 5 slightly shorter than segment 3, each 1.5 times as long as wide. Segment 6 to 8 slightly shorter than segments 4 or 5. Segment 9 about 1.2 times as long as wide, distinctly shorter and slightly wider than pedicel. Segment 10 slightly larger than 9, almost as wide as scape, slightly longer than wide. Segment 11 almost as long as segments 7 to 10 combined, about 2.5 times as long as wide, shorter and wider than scape.

Pronotum 0.37–0.38 mm long, 0.39–0.40 mm wide. Antebasal sulcus sinuate, well delimited, not widened in middle. Punctuation between antebasal sulcus and base irregular, partly coarse and dense, not confluent. Lateral portions of disc extremely finely punctate. Middle portion of disc irregularly punctate in ♂, with punctures mostly shallow, about as large as coarse punctures situated between antebasal sulcus and basal edge; most of discal punctuation extremely shallow and hardly visible in ♀.

Elytra 0.69–0.74 mm long, combined 0.70 mm wide. Basal area obliquely inflexed, not raised. Basal foveae deep, well delimited, hardly half as large as interval between them. Humeral hump low in ♂, absent from ♀. Discal punctuation extremely fine.

Profemora tuberculate. Protibiae straight, becoming gradually stouter apically, with deep subapical notch and denticle in ♂. Mesotibiae hardly curved, becoming stouter toward middle, evenly thick in apical half. Metatibiae becoming slightly stouter toward apical third, in apical third curved, with an apical denticle in ♂.

Aedeagus (Fig. 6) damaged, about 0.25 mm long. Parameres with apical portion evenly wide, straight outer edge and almost straight inner edge; apex of parameres truncate or hardly rounded. Each paramere with 2 hair-like subapical sensilla. Internal sac with two small, curved basal sclerites and one median vesica lying over a central plate. Apical portion of internal sac consisting of weakly sclerotised plates.

Comments. This species may be distinguished by the elytral pubescence which is recumbent and much shorter than the pronotal pubescence, the long tempora, and the coarse pronotal punctuation in the ♂.

***Bythoxenites pubiceps* sp. n.**

Holotype ♂: Japan, Nagano pref., J.E. Kogen National Park, Shiga, 1500 m, 23.VII.1980, leg. I. Löbl, moist leaf litter and soil sample on rocky ground of a steep slope (MHNG).

Length 1.75 mm. Head and body uniformly reddish-brown, appendages lighter. Pubescence short, semi-erect on head, pronotum and elytra, recumbent on abdomen.

Head 0.39 mm long, with eyes 0.40 mm wide; frons 0.22 mm wide anteriorly. Frontal impression deep, wide and short, finely and sparsely punctate, ending abruptly just posterior to level of antennal insertion. Anterior portion of frons impressed between antennal tubercles but distinctly raising above frontal impression, coarsely

and very densely punctate, prominent in middle. Frontoclypeus vertical, rounded and wide, covered by short dense pubescence orientated ventrally. Antennal tubercles raised, smooth, each slightly narrower than frontal impression. Frons distinctly narrowed posterior to antennal tubercles, then gradually widened toward eyes, with dorsal edges of genae straight and sharp. Vertex strongly raised, except for flat lateral portions. Dorsal tentorial pits inconspicuous, situated somewhat posterior to level of anterior eye margin, slightly closer to eye margin than to vertexal mid-line. Vertexal sulci shallow, consisting of smooth narrow lines converging toward frontal impression. Middle, raised anterior portion of vertex abruptly delimited by an angular carina and strongly inflexed toward frontal impression. Inflexed area smooth. Mesal carina of vertex fairly high, extending anteriorly over smooth inflexed area, and, apically, over raised dorsal portion of vertex. Vertexal punctuation very dense, consisting of coarse punctures on raised middle area; punctures about as large as facets, separated by narrow ridges. Punctuation on lateral portions of vertex consisting of much smaller punctures. Eyes large, convex, prominent, with numerous facets, longer than tempora in lateral or dorsal view. Tempora rounded. Neck with a single, low dorsomedian ridge.

Postgenae strongly inflexed ventrally between neck and gular groove. Gular area similar to that in *B. longicornis*, but setae arising from prominent middle portion of posterior edge of gular groove orientated toward bottom of groove. Area between gular groove and mouthparts inflexed, with low median ridge.

Maxillary palpi with 2nd segment tuberculate, except on slender basal portion; 3rd segment hardly longer than wide, tuberculate; 4th segment 0.34 mm long, about 3.5 times as long as wide, with outer margin almost straight.

Antennae short. Scape straight and subcylindrical in dorsal view, about 2 times as long as wide; curved and with slightly concave ventral side in lateral view. Pedicel subcylindrical, narrowed basally, slightly longer than wide, in length hardly exceeding width of scape. Segment 3 elongate, about 1.5 times as long as wide, somewhat shorter than pedicel. Segments 4 to 8 evenly large, each as large as segment 3 and as large as long. Segment 9 as long as segment 3, slightly wider than long. Segment 10 as long as 9, but distinctly wider. Segment 11 about 2 times as long as wide, as long as segments 8, 9 and 10 combined, slightly longer than scape.

Pronotum 0.42 mm long, 0.46 mm wide. Antebasal sulcus sinuate, well delimited posteriorly, not widened in middle. Punctuation very dense between antebasal sulcus and basal edge, consisting of irregular, partly confluent, mostly deep and fairly large punctures. Punctuation rather dense and evenly very fine on area between antebasal sulcus and anterior edge, with punctures several times smaller than intervals between them.

Elytra 0.75 mm long, combined 0.79 mm wide, with lateral edges rounded in apical half, almost evenly vaulted dorsally. Basal foveae deep, well delimited, distinctly smaller than interval between them. Humeral hump fairly high, elongate. Discal punctuation very fine and sparse, punctures about as small as those on middle portion of pronotum.

Profemora with several extremely low tubercles grouped near base. Protibiae slightly curved, gradually stouter toward deep subapical notch, with subapical

denticle. Mesotibiae straight in basal half, gradually stouter toward middle, curved in apical half and narrowed from middle to apex. Metatibiae straight and becoming stouter toward apical third, distinctly curved and evenly wide in apical third, with apical denticle.

Aedeagus (Fig. 7) 0.28 mm long. Parameres almost evenly wide, with sinuate inner edge, irregular rounded outer edge. Each paramere with 3 hair-like subapical sensilla. Internal sac with a basal complex sclerite (extruded and thus apical in the unique known specimen).

Comments. This species may be distinguished by the shape of the frons in combination with the short frontoclypeal pubescence.

***Bythoxenites longiceps* sp. n.**

Holotype ♂: Japan, Gifu pref., Nojiri A-cave, 21.XI.1971, leg. M. Tanaka (MHNG).

Length 2.05 mm. Ochreous, elytra, antennae and legs lighter than head, pronotum, abdomen and maxillary palpi (examined specimen is likely teneral). Pubescence fairly short, semi-erect on head, pronotum and elytra, recumbent on abdomen.

Head 0.43 mm long, with eyes 0.38 mm wide; frons 0.25 mm wide anteriorly. Frontal impression wide and deep, narrowed posteriorly, gradually inflexed anteriorly to form upper surface of strongly prominent frontoclypeus; with very dense, irregular punctation. Anterior frontal edge subangular. Antennal tubercles raised, smooth, each much narrower than frontal impression. Frontoclypeus narrowed mesally, bearing dense recumbent pubescence orientated ventrally. Frons strongly narrowed posterior to antennal tubercles, then gradually widened toward eyes. Dorsal genal edge straight, sharply delimited. Dorsal tentorial pits situated slightly posterior to level of anterior eye margin, at mid-distance from eye margin to vertexal mid-line. Vertexal sulci distinct, narrowed and converging anteriorly, fairly deep, smooth, vanishing just before reaching frontal impression. Middle of vertex raised, with anterior surface strongly inflexed and smooth, delimited by an inverted V-shaped ridge. Posterior portion of vertex rounded. Mesal carina high, starting posterior to level of tentorial pits, extended anteriorly over inflexed and smooth mesal surface, reaching frontal impression. Neck and posterior portion of vertex with a median ridge narrowly separated from vertexal carina. Vertexal punctation very dense and fairly coarse, punctures irregularly large, mostly smaller than facets, partly confluent, separated by narrow ridges. Eyes large, prominent, with numerous facets, as long as tempora in lateral view. Exposed dorsal surface of neck irregularly wrinkled, with distinct median ridge.

Postgenae strongly inflexed between neck and gular groove, bearing long curved setae. Area between ventral tentorial pit and neck with a fairly high mediobasal carina. Gular groove similar as in *B. longicornis*, deep, with posterior and lateral edges obtuse. Posterior edge prominent in middle and bearing two horizontal, divergent tufts of setae. Anterior edge with two vertical, mesally converging laminae. Area between mouthparts and gular groove impressed, with a median ridge.

Maxillary palpi with 2nd segment tuberculate, except in basal third; 3rd segment slightly longer than wide, tuberculate; 4th segment large, 0.43 mm long, almost 5 times as long as wide, with concave outer margin.

Antennae long. Scape in dorsal view straight, cylindrical, almost 4 times as long as wide, with dorsobasal impression and ridge obsolete. Scape in frontal view slightly curved, narrowed toward base, hardly flattened ventrally. Pedicel subcylindrical, slightly narrowed basally, in length exceeding width of scape, about 1.5 times as long as wide. Segments 3 to 8 evenly wide, about as wide as 3/4 of pedicel. Segments 4 and 5 evenly large, slightly shorter than segment 3. Segments 6 to 8 evenly large, slightly shorter than segment 5. Segments 9 and 10 evenly long, each hardly shorter than pedicel, 9 slightly longer than wide, 10 as long as wide. Segment 11 somewhat longer than segments 9 and 10 combined, slightly shorter than scape, about 2.2 times as long as wide.

Pronotum 0.46 mm long, as long as wide. Antebasal sulcus sinuate, deep, well delimited posteriorly, not widened in middle. Punctuation coarse and very dense between antebasal sulcus and base, consisting of fairly regularly large punctures; intervals between punctures much smaller than puncture diameters. Punctuation rather dense and extremely fine on entire area between antebasal sulcus and anterior pronotal edge.

Elytra 0.80 mm long (somewhat deformed, width not measured). Basal foveae deep, well delimited, slightly smaller than interval between them. Humeral hump low, elongate. Discal punctuation sparse and very fine, consisting of punctures slightly larger than those on pronotal center.

Profemora not tuberculate. Protibiae straight, becoming gradually stouter toward subapical notch, with distinct subapical denticle. Mesotibiae hardly curved, becoming stouter toward apical third. Metatibiae almost evenly stout, slightly curved in apical third, with apical denticle.

Aedeagus (Fig. 8) damaged, about 0.50 mm long. Parameres gradually widened toward apex, with angulate outer and apical edges; inner edge almost straight. Each paramere with 3 hair-like subapical sensilla. Internal sac simple, with slender basal sclerites and wide apical plate.

Comments. This species may be distinguished by the elongate head and the shape of the frons and the vertexal carina.

***Bythoxenites frontalis* sp. n.**

Holotype ♂: Japan, Gunma pref., 4 km SW Tsumagoi, 1050 m, near a river, 18.VII.1980, leg. I. Löbl (nr 7b) leaf litter at foot of a steep rocky slope (MHNG).

Paratypes: 7 ♂, 24 ♀, as holotype (MHNG, PCSK); 3 ♂, 8 ♀, Nagano pref., J.E. Kogen Nat. Park, Shiga, 1500 m, forest in a ravine, 23.VII.1980, leg. I. Löbl (nr 17b + c), moist leaf litter, humus, and under bark of *Abies* (MHNG, CSKM); 1 ♂, Gunma pref., below Usui Pass, 850 m, 24.VII.1980, leg. I. Löbl (nr 19b) forest leaf and wood litter on a slope, in a ravine (MHNG); 1 ♀, same data but 750 m, 20.VII. (nr 12b) leaf litter along a small stream (MHNG); 1 ♀, same data but 900 m, 25.VII. (nr 20b) in leaf and wood litter along a log (MHNG).

Length 1.40–1.60 mm. Head and body uniformly reddish-brown, appendages lighter. Pubescence long, semi-erect on head, pronotum and elytra, recumbent on abdomen.

Head 0.34–0.36 mm long, with eyes 0.33–0.36 mm wide in ♂, and 0.31–0.32 mm wide in ♀. Frons anteriorly 0.19–0.20 mm wide. Frontal impression wide and punctate, in ♂ shallow and very short, not extending posterior to level of antennal tubercles, in ♀ deep, much longer than in ♂, similar to that in other species of the group. Frons in ♂ delimited from above by minute transverse ridge; surface inflexed toward frontal impression smooth, but with two long setae orientated anteriorly. Antennal tubercles raised, smooth, each distinctly narrower than frontal impression. Anterior edge of frons sharply delimited, prominent and angulate. Frontoclypeus almost vertical, rounded below, with long setae orientated anteriorly. Frons narrowed posterior to antennal tubercles, then widened gradually toward eyes. Dorsal genal edge straight and sharp. Vertex relatively flat. Dorsal tentorial pits situated in a small impression, at level of anterior eyes margin in ♂, slightly anterior to anterior eye margin in ♀. Vertexal sulci inconspicuous, very narrow and shallow, traceable from tentorial pits to frontal impression. Mesal carina evenly low from frontal impression to level of tentorial pits in ♂, shortened in ♀. Area on each side of mesal carina in same level as, or slightly below level of, vertex, moderately raised above lateral edges, irregularly and finely punctate in ♂, more coarsely punctate in ♀. Punctuation on vertex and along lateral edges of frons coarse and very dense, many punctures larger than facets, separated by narrow ridges, sometimes confluent. Eyes in ♂ large, prominent, with numerous facets, longer than tempora in lateral view. Eyes in ♀ small but prominent, consisting of 12 to 14 facets, shorter than tempora in lateral view. Tempora rounded. Neck dorsally with a median ridge and irregular fine punctuation, or finely rugose.

Postgenae oblique and strongly inflexed, bearing long setae curved anteriorly. Gular groove in ♂ transverse, deep, with sharp anterior, obtuse posterior edges. Posterior edge prominent in middle and bearing two flat, obliquely divergent horizontal tufts of short setae; anterior edge of gular groove with two minute vertical laminae. Area between gular groove and mouthparts impressed, with a low median ridge.

Maxillary palpi with 2nd segment bearing low apical tubercles; 3rd segment tuberculate; 4th segment 0.27–0.30 mm long, about 3 times as long as wide, with slightly convex outer margin.

Antennae fairly short. Scape subcylindrical, about 2 times as long as wide, somewhat narrowed apically, flattened ventrally, with straight posterior edge and slightly convexly rounded anterior edge in dorsal view. Dorsobasal scapal ridge indistinct, except laterally. Pedicel elongate-oval, as long as scape wide, 1.4 times as long as wide. Segments 3 to 8 evenly wide. Segment 3 elongate, shorter than pedicel, as wide as 4/5 of pedicel. Segment 4 as long as wide. Segments 5 to 8 each slightly shorter than 4. Segments 9 and 10 slightly shorter than 3, both distinctly wider than long, segment 10 larger than 9. Segment 11 about 2 times as long as wide, as long as segments 8 to 10 combined.

Pronotum 0.37–0.39 mm long, 0.40–0.42 mm wide. Antebasal sulcus sinuate, well delimited, widened in middle. Punctuation irregular, coarse and very dense, partly

confluent between antebasal sulcus and basal edge; intervals between punctures formed mostly by narrow ridges. Punctuation sparse and very fine on area between antebasal sulcus and anterior pronotal edge, some specimens with large but extremely shallow punctures on centre of pronotal disc.

Elytra 0.65–0.68 mm long in ♂, 0.60–0.64 mm long in ♀, combined 0.64–0.72 mm wide. Basal foveae deep, well delimited, smaller than interval between them. Humeral hump low but distinct in ♂, obsolete in ♀.

Profemora lacking tubercles. Protibiae in ♂ slightly curved, gradually stouter toward apical third, with shallow subapical notch and small denticle. Mesotibiae in ♂ straight and becoming gradually stouter toward apical third, in apical third evenly thick and curved. Mesotibia in ♀ becoming stouter toward middle and curved in middle portion. Metatibiae in both sexes becoming slightly stouter toward middle, slightly curved in apical half.

Aedeagus (Fig. 9) 0.32–0.35 mm long. Parameres slightly narrowed apically, with almost straight inner edge, outer edge concave near apex, each paramere bearing 3 hair-like sensilla. Internal sac with two small, basal, elongate denticles, one long curved central sclerite, two weakly sclerotised apical laminae, and a central membranous vesicle.

Comments. This species may be readily identified by the very short frontal impression in ♂.

Bythoxenites species A

Material: 1 ♀, Japan, Tochigi pref., Nikko Nat. Park, Chuzenji, 1350 m, 14.VII.1980, leg. I. Löbl (no 1); bamboo leaf litter with rotten wood at a forest edge (MHNG).

This specimen may be distinguished by the following characters: Length 1.75 mm; pubescence long and semi-erect (except on abdomen); anterior edge of frons prominent; frontoclypeus narrowed mesally to form a keel, bearing long erect setae; vertex flattened, with mesal carina very low, extending from edge of frontal impression to transverse ridge of neck; eyes prominent, with 11 or 12 facets; antennae with pedicel and 3rd segment evenly long, segments 4 to 6 gradually shorter, 6 to 8 evenly long; maxillary palpi with 4th segment about 4 times as long as wide; pronotum very finely punctate between antebasal sulcus and anterior pronotal edge.

The specimen obviously represents a distinct species. In absence of the knowledge of the male sexual characters, we cannot define it adequately, and prefer not to name it.

ACKNOWLEDGEMENTS

Mr S. Hisamatsu, Matsuyama, provided useful information on collecting sites in Shikoku. His hospitality made the stay of the senior author to Japan very pleasant. Drs Jarmila Kukalova-Peck, Stewart B. Peck, Kohei Sawada, Ales Smetana, and Masahiro Tanaka provided interesting additional material. The comments of Donald S. Chandler led to improvement of the paper and are gratefully acknowledged.

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Nouveaux Cholevinae d'Asie (Coleoptera Leiodidae)

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New Cholevinae from Asia (Coleoptera Leiodidae). - Following new taxa of Leiodidae Cholevinae from China and Far East Russia are described: *Pandania sinica* n. sp., *Nemadus sichuanus* n. sp., *Anemadiola kurbatovi* n. sp., *Anemadus wolongianus* n. sp., a new subgenus of *Nargus*: *Eunargus*, and *Sciaphyes kurbatovi*. *Sciaphyes* is redescribed and the presence of a likely new species is discussed. This genus is notable by the 5-segmented protarsi in the female. The characters used to define the Leptoderini and the possible paraphy of this taxon are discussed.

Key-words: Coleoptera - Leiodidae - Cholevinae - China - Far East Russia - Taxonomy.

INTRODUCTION

Cet article s'inscrit dans une série d'études sur la faune des Cholevinae d'extrême-orient. De nombreuses lignées endémiques de cette région ont déjà été mises en évidence par les travaux de Szymczakowski, Nakane, Hayashi, Miyama, Nishikawa et Perreau, et ont été résumées dans un article précédent (PERREAU, 1996). Le présent travail expose de nouvelles découvertes effectuées par S. Kurbatov lors de plusieurs expéditions en Chine et en Russie d'extrême-orient, et continue de montrer que cette région a été le lieu de nombreuses spéciations, et l'origine d'un grand nombre de lignées.

La localisation des spécimens examinés est indiquée comme suit: Muséum d'histoire naturelle de Genève: MHNG; et collection M. Perreau: CMP.

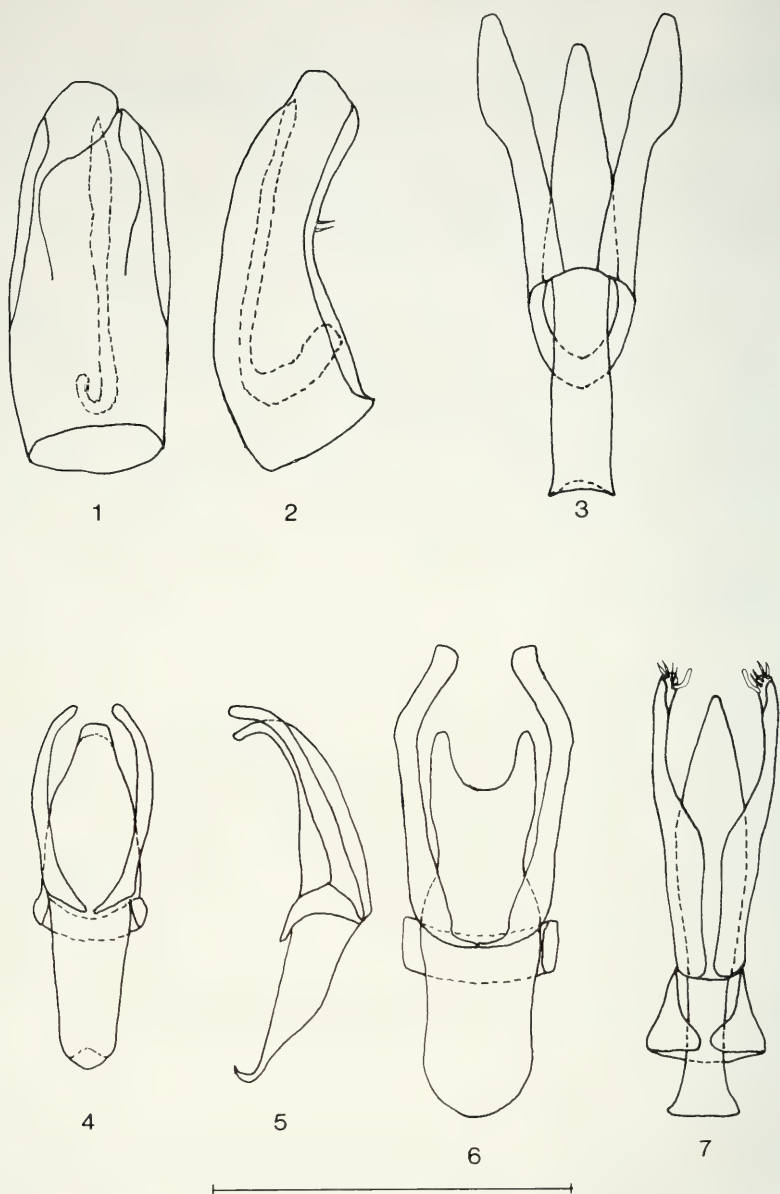
TAXONOMIE

Pandania sinica n. sp.

Holotype ♂: Chine, S. Yunnan, réserve naturelle de Mangyang, 500 m dans du bois pourri, 11.X.1994, Kurbatov leg. (MHNG).

Description: Longueur: 2,9 mm. Espèce ailée, de coloration brune uniforme, un peu plus foncée sur la tête. Tout le corps recouvert d'une fine pubescence dorée.

Tête non striolée transversalement, finement ponctuée et microréticulée entre les points. Suture clypeo-frontale absente. Yeux bien développés. Antennes com-



FIGS 1-7

Edéages. 1: *Pandania sinica* n. sp., face dorsale. 2: *Pandania sinica* n. sp., face latérale. 3: *Nemadus sichuanus* n. sp., face dorsale. 4: *Anemadiola kurbatovi*, n. sp., face dorsale. 5: *Anemadiola kurbatovi*, n. sp., face latérale droite. 6: *Anemadus wolongianus* n. sp., face dorsale. 7: *Sciaphyes kurbatovi* n. sp., face dorsale. L'échelle représente 0,6 mm pour la figure 3, et 0,4 mm pour les figures 1, 2, 4, 5, 6, 7.

pactes, les articles non rétrécis en avant ni en arrière, au niveau de leur insertion. La formule antennaire est la suivante (longueur des antennomères en micromètres): 165, 95, 50, 55, 65, 45, 105, 50, 95, 295 (précision: 5 micromètres). Le dernier antennomère est donc particulièrement long.

Pronotum 1,57 fois plus large que long, la plus grande largeur près de la base. Surface non striolée transversalement, assez finement et densément ponctuée, et microréticulée entre les points. Cette sculpture est similaire à celle de la tête.

Elytres 1,3 fois plus longs que larges. Surface finement striolée transversalement, et microréticulée entre les stries. Structure sternale conforme au plan de base des *Ptomaphagina*.

Tibias antérieurs bordés d'une rangée de petites épines égales sur le bord apical antérieur, et sur le bord externe, comme chez tous les *Ptomaphagina*. Tarses antérieurs et intermédiaires non dilatés. Tous les tarses comprimés, étroits, et épais.

Segment IX avec un spiculum gastrale ne dépassant pas en avant le bord antérieur des latérotergites.

Edéage ovale, conforme au plan de base des *Ptomaphagus*, épais et arrondi à l'extrémité, avec deux soies perpendiculaires au plan du lobe médian situées au milieu de sa longueur, et latéralement. Stylet interne long et grêle, (figures 1 et 2).

Femelle inconnue.

Nous plaçons cette espèce dans le genre *Pandania* Szymczakowski, 1964, dont elle présente le caractère distinctif principal: la ponctuation non alignée en stries transversales sur le pronotum. Une seule espèce était connue jusqu'à présent dans ce genre: *Pandania oxytropis* Szymczakowski, 1964, récoltée à Sumatra, et dont le mâle est toujours inconnu. *P. sinica* est bien différente car nettement moins trapue. D'autres caractères importants séparent ces deux espèces: la ponctuation du pronotum est plus serrée et plus grosse chez *P. sinica*, la carène mésosternale est basse de même que chez tous les *Ptomaphagus*, et non pas haute et anguleuse comme chez *P. oxytropis*. La conformation des antennes de *P. sinica*, compactes et avec l'antennomère 11 particulièrement long évoque tout à fait celles des *Philomessor*, *Attaephilus*, et de certains *Catopomorphus*, et diffère notamment de celles de *P. oxytropis*. Ce parallélisme dans deux lignées bien différentes de Cholevinae peut surprendre. Un mode de vie semblable peut être une explication, et ceci suggère pour *P. sinica* une propension à la myrmécophilie. Rien n'est connu sur la biologie de *P. sinica* excepté qu'elle a été récoltée dans du bois en décomposition. Cet habitat est assez surprenant pour un *Ptomaphagini* dont les espèces sont en général récoltées dans la litière des forêts.

Toutes les différences morphologiques séparant les deux espèces rendent très hypothétiques les relations de cette nouvelle espèce avec *P. oxytropis*. Il faudra attendre de connaître le mâle de *P. oxytropis* et la femelle de *P. sinica* pour confirmer si ces deux espèces sont bien congénériques ou s'il faut isoler *P. sinica* dans un genre à part.

***Nemadus sichuanus* n. sp.**

Holotype ♂: Chine, Sichuan, mont Emei, 1400 m, débris végétaux, 22.IX.1994, leg. S. Kurbatov (MHNG).

Description: Longueur: 2,35 mm. Espèce ailée. Corps brun foncé, recouvert d'une fine pubescence dorée couchée. Les six premiers articles antennaires et le dernier un peu plus clairs.

Tête à ponctuation très fine, mais à microréticulation très marquée.

Pronotum à ponctuation fine et à microsculpture extrêmement fine et très dense entre les points, sans structure précise.

Elytres microstriolées transversalement et microréticulés entre les stries.

Tibias antérieurs présentant une échancrure sur son bord apical inférieur et interne (figure 8). Tarses antérieurs fortement dilatés en une large palette impliquant les quatre premiers articles, et environ deux fois aussi larges que la largeur des tibias (figure 8). Tarses intermédiaires à premier article très fortement dilaté.

Edéage représenté sur la figure 3.

Femelle inconnue.

Cette espèce se distingue très facilement par l'échancrure de la troncature apicale des tibias antérieurs sur leur face ventrale. On ne peut s'empêcher, en observant ce caractère singulier, de suggérer une ressemblance avec l'organe de toilette de certains Carabidae, particulièrement dans les cas les plus primitifs de celui-ci. Toutefois cette ressemblance est probablement fortuite, car on n'observe pas la migration conjointe de l'épine apicale qui accompagne toujours la présence de l'organe de toilette des Carabidae. Par ailleurs, rien ne permet actuellement de présumer de la fonction d'une telle structure chez un *Nemadina*, d'autant que l'on connaît bien peu de choses sur la biologie de ce groupe.

***Micronemadus pusillimus* Kraatz**

1 ♂ et 1 ♀, Chine: W Hebei, réserve naturelle de Shannongj, 2000–2200 m, 3 à 8.VI.95, S. Kurbatov leg. (MHNG).

1 ♂ et 1 ♀, Chine: Sichuan, réserve naturelle de Wolong, 900 m, dans des débris végétaux, 24.V.1994, S. Kurbatov leg. (MHNG).

***Anemadiola kurbatovi* n. sp.**

Holotype ♂: Chine, NE Guangxi, 15 km N Longscheng, 1000 m, débris végétaux, 20.VI.1995, leg. S. Kurbatov (MHNG).

Paratypes 15 exemplaires (sexes non examinés): même provenance, entre le 15.VI et le 20.VI.1995 (MHNG, CMP).

Description: Longueur: 1,8 mm. Tout le corps recouvert d'une pubescence assez longue inclinée vers l'arrière, mais en partie dressée. Coloration générale brun sombre, les antennomères 4 à 11 pratiquement noirs.

Ponctuation céphalique assez fine et peu profonde (par rapport à celle du pronotum), l'intervalle entre les points pratiquement lisse. Suture clypéo-frontale bien visible.

Pronotum à ponctuation très grosse, très profonde et très serrée mais non rugueuse, les points souvent confluent, et le peu d'espace libre parfaitement lisse. Côtés du pronotum sinués à la base, de telle manière que les angles postérieurs sont

droits. Deux fovéoles sont présentes latéralement, au niveau du tiers basal, et du quart latéral. La fovéole la plus interne est située un peu plus en arrière que l'autre. Base nettement rebordée.

Elytres striolées transversalement, avec de très gros points enfoncés dans les stries longitudinales, et une microréticulation entre les strioles.

Tarses antérieurs légèrement dilatés, mais moins larges que l'apex du tibia. Deux premiers articles des tarses intermédiaires dilatés.

Édéage régulièrement rétréci de la base à l'apex, recourbé vers le bas comme toutes les autres espèces du genre, mais la courbure est plus régulière sur toute la longueur de l'édéage, alors que chez les autres espèces, elle est localisée sur la deuxième moitié de la longueur (figures 4 et 5). Lame basale du tegmen réduite à une bandelette étroite. Sac interne muni de deux rangées de phanères dans la première moitié de sa longueur, puis régulièrement tapissé de petites écailles dans sa deuxième moitié.

Femelle semblable au mâle à l'exception de la dilatation des tarses. Le ventrite VIII et le spiculum ventrale sont représentés sur la figure 18.

A. kurbatovi est la première espèce d'*Anemadiola* continentale. Trois espèces étaient jusqu'à présent connues de Taiwan: *A. itotateoi* Hayashi, 1990 et *A. smetanai* Perreau, 1996, et du Japon *A. inordinata* Szymczakowski, 1963. L'édéage d'*A. kurbatovi* dont la courbure apicale est moins prononcée et dont l'amincissement est régulier est le plus primitif parmi les quatre espèces, suggérant pour le genre *Anemadiola* une origine continentale. Toutefois, la morphologie externe rapproche cette espèce de *A. itotateoi*. Toutes deux présentent en effet des fovéoles basales sur le pronotum, et une ponctuation très forte sur le pronotum et les élytres.

Le tableau de détermination des espèces d'*Anemadiola*, donné dans un précédent article (Perreau, 1996), peut être modifié comme suit pour y intégrer *A. kurbatovi*:

- 1 Pronotum sans fovéole basolatérale. Côtés du pronotum non sinués devant les angles postérieurs qui sont obtus. Elytres sans ponctuation autre que les petits points alignés en strioles transversales 2
- Pronotum avec des fovéoles basolatérales. Sinuosité des côtés du pronotum marquée, les angles postérieurs droits ou légèrement aigus. Elytres avec des points alignés longitudinalement à la place des stries 3
- 2 Forme large et trapue. Les angles postérieurs du pronotum arrondis. La surface du pronotum régulièrement convexe *inordinata* Szymczakowski
- Forme plus allongée. Les angles postérieurs du pronotum obtus mais marqués. La surface du pronotum aplatie près des angles postérieurs *smetanai* Perreau
- 3 Pronotum avec deux fovéoles, situées symétriquement au quart de la largeur du pronotum, et au tiers de sa longueur. Surface pronotale à ponctuation fine et espacée, la surface lisse entre les points . . . *itotateoi* Hayashi
- Pronotum avec quatre fovéoles: deux de chaque côtés, situées symétriquement au quart de la largeur pronotale, et au tiers de sa longueur, la fovéole la plus interne un peu plus en arrière que l'externe. Surface du pronotum très irrégulière, la sculpture formée de gros nodules saillants très proches les uns des autres *kurbatovi* n. sp.

Anemadus wolongianus n. sp.

Holotype ♂: Chine, Sichuan, réserve naturelle de Wolong, 900 m, 23.V.1994, débris végétaux, leg. S. Kurbatov (MHNG). Paratypes 2 ♀, même provenance (MHNG, CMP).

Description: Longueur: 2,35 mm. Coloration générale brun-jaune clair, seuls les cinq derniers articles antennaires rembrunis. Tout le corps couvert d'une fine pubescence dorée, couchée.

Ponctuation céphalique très forte et très dense, mais non rugueuse. Suture clypéo-frontale très forte. Le bord antérieur du clypeus très arrondi.

Pronotum à angles postérieurs largement arrondis, la base finement rebordée sauf près des angles postérieurs. Ponctuation très forte, rugueuse, confluyente en lignes transversales en certains endroits, mais pas suffisamment pour former des stries transversales telles que chez certains *Nemadini*.

Elytres striolées transversalement.

Tarses antérieurs légèrement dilatés, mais nettement moins larges que l'apex du tibia. Les deux premiers articles des tarses intermédiaires très faiblement dilatés.

Édage à lobe médian très large, l'apex profondément échancré (figure 6). Sac interne primitif, avec deux rangées de phanères.

Femelle semblable au mâle, à l'exception de la dilatation des tarses. Ventrite VIII et spiculum ventrale représentés sur la figure 17.

L'édage de cette espèce est très caractéristique, l'apex est très large et très largement échancré, et permet une reconnaissance aisée de l'espèce (figure 6). De plus la petite taille n'autorise aucune confusion avec des espèces déjà connues.

Nargus (Eunargus) n. subgen.

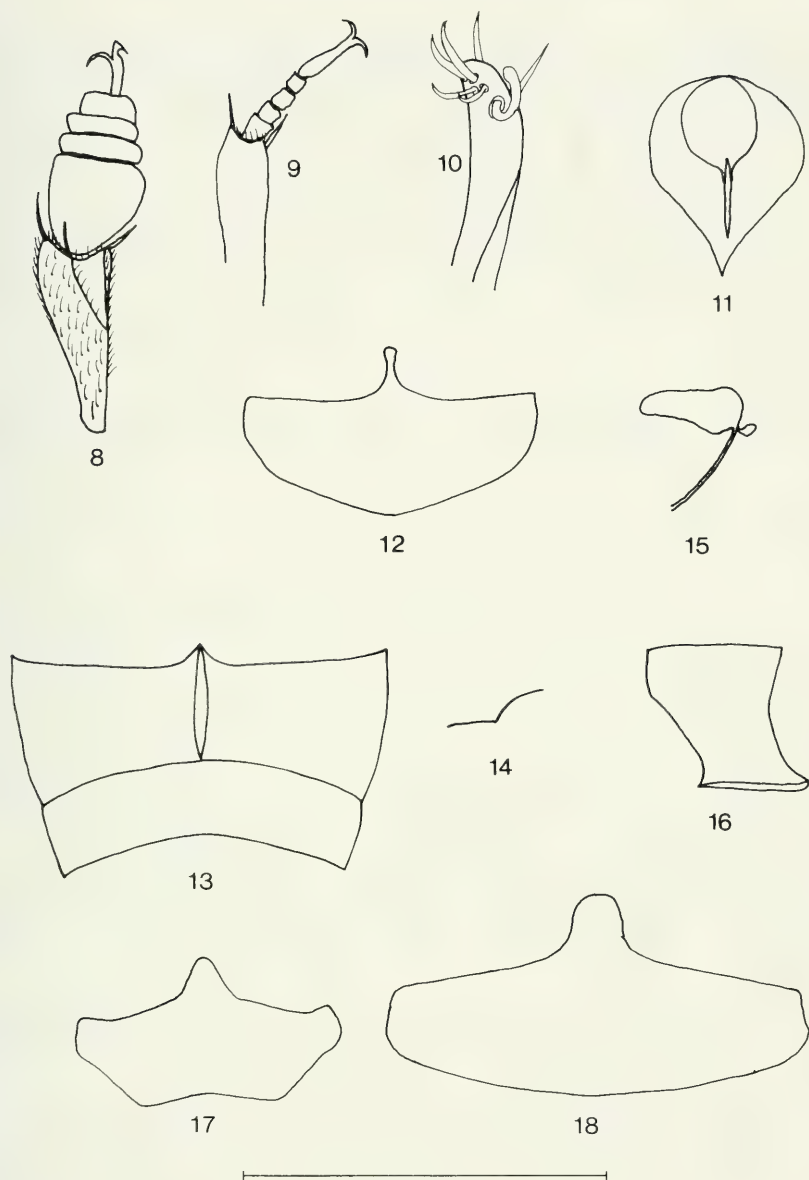
Espèce-type: *Nargus taiwanensis* Perreau, 1996

Le caractère le plus important qui isole ce sous-genre des deux autres: *Nargus* s. str. et *Demochrus* est la conformation particulière de l'édage. Les zones dorsale et ventrale du lobe médian sont constituées de deux longues lames bifurquées à l'apex et qui se croisent à leur extrémité, la première se déplaçant vers la gauche, et la seconde vers la droite. Le sac interne est muni de courtes dents isolées, de phanères, et à la base, d'une très forte dent.

Par comparaison avec les deux autres sous-genres, la taille est comparable à celle des grandes espèces du sous-genre *Nargus* s. str., mais l'absence de rangées de soies égales à l'apex des tibias, le rapproche des *Demochrus*.

L'évolution de l'organe copulateur rappelle celle rencontrée chez les *Catopina* du genre endémique japonais *Apterocatops* Nakane. Une meilleure compréhension de la signification fonctionnelle de telles modifications structurales permettra peut-être de préciser l'origine de cette évolution parallèle dans les deux sous-tribus, et se produisant dans la même région.

Lors de la description du *Nargus (Eunargus) taiwanensis* Perreau, cette dernière était la seule espèce connue présentant ces caractères originaux, nous n'avions pas proposé de séparation générique ou subgénérique ne sachant pas s'il s'agissait d'une espèce présentant isolément des caractères particuliers, ou si l'on était en présence d'une lignée nouvellement découverte et comportant d'autres espèces encore inconnues.



FIGS 8-18

8: *Nemadus sichuanus* n. sp., tibia et tarse antérieurs droits face ventrale. Figures 9 à 14. *Sciaphyes kurbatovi* n. sp. 9: tibia et tarse antérieurs droits face dorsale (femelle). 10: apex du paramère droit face ventrale interne. 11: segment IX (mâle). 12: ventrite VIII et spiculum ventrale (femelle). 13: ventrites des 4 premiers urites abdominaux, face ventrale (femelle). 14: bord inférieur de la carène mesosternale (mâle). Figures 15-16. *Sciaphyes* sp., femelle. 15: spermathèque. 16: Ventrite des trois premiers urites abdominaux face latérale. Figure 17: *Anemadus wolongianus* n. sp., ventrite VIII et spiculum ventrale (femelle). Figure 18: *Anemadiola kurbatovi* n. sp., ventrite VIII et spiculum ventrale (femelle). L'échelle représente 0,14 mm pour la figure 10, 0,6 mm pour les figures 8, 13, 14, 16 et 17 et 0,4 mm pour les figures 9, 11, 12, 15 et 18.

Or plusieurs exemplaires d'une autre espèce nouvelle, présentant des caractères analogues, figurent dans les collections du Muséum d'histoire naturelle de Genève, et proviennent de la province de Sichuan en Chine. Par ailleurs, mon collègue et ami Jürgen Frank de Stuttgart, possède également plusieurs exemplaires de cette même espèce, provenant également de Chine. Il ne fait plus de doute maintenant que l'on est ici en présence d'une nouvelle lignée, dont d'autres espèces peuplent probablement l'Asie d'extrême-orient. C'est la raison pour laquelle nous décrivons un sous-genre nouveau. Jürgen Frank m'ayant auparavant fait part de son intention de décrire l'espèce nouvelle, je lui laisse la priorité.

Sciodrepoides watsoni Spence

4 ♂ et 1 ♀, W. Siberia: 250 km à l'est de Kurgan, environs de Kazanskoye, 17.VI à 20.VI.1993, leg. S. Kurbatov (MHNG).

Scyaphyes Jeannel, 1910

Espèce-type: *Bathyscia sibirica* Reitter, 1887

Nous donnons ici une description complémentaire de ce genre et de la description d'une espèce nouvelle:

Forme bathyscioïde allongée, parallèle. Espèces aptères, à coloration générale brun clair, dépigmentée. Tout le corps recouvert d'une pubescence longue et éparse.

Tête microréticulée, mais non microstriolée. Carène occipitale régressée, seulement présente sous forme de deux courtes carènes situées en arrière des yeux. Ces derniers, très petits, sont réduits à quelques ommatidies et totalement dépigmentés. Suture clypeofrontale présente. Palpes maxillaires à second article large et épais, le troisième court et conique. Les deux premiers antennomères de même longueur.

Pronotum microréticulé transversalement, mais non microstriolé, large à la base et rétréci vers l'avant, nullement rebordé, ni le long du bord antérieur, ni du bord postérieur.

Elytres microstriolés transversalement. Cavités mésocoxales séparées par une carène basse. Cavités métacoxales également distantes, séparées par un processus étroit mais distinct. Métastrernum présentant deux sillons latéraux symétriques, débutant en arrière des cavités mésocoxales et dirigés vers l'arrière.

Arceau ventral correspondant à la fusion des trois premiers urites abdominaux muni d'une fine carène longitudinale médiane sur toute sa longueur (figures 13 et 16).

Troncature apicale des tibias intermédiaires et postérieurs portant deux fortes épines externes et une rangée de petites épines à peu près égales. Tarses antérieurs pentamères dans les deux sexes. Onychium présentant deux soies non articulées entre les deux ongles.

Spermathèque nullement sclérifiée, membraneuse, en forme de poire allongée (figure 15). Ventrite VIII femelle muni d'un spiculum ventrale (figure 12).

Edeage complet, avec des paramères bien développés et présentant au moins une soie apicale interne très forte recourbée vers l'arrière et non effilée à l'apex

(figure 7). L'apex des paramères présente bien d'autres soies dont le nombre semble dépendre de l'espèce. Le sac interne est simplement tapissé de dents hyalines indifférenciées. L'urite IX est réduit à un cadre grossièrement circulaire entourant l'édéage (figure 11).

Discussion: Lors de sa description, Jeannel plaça *Sciaphyes* au sein des Leptodirini du groupe des Euryscapes. L'examen détaillé montre plusieurs caractères inhabituels pour ce groupe. La pentamerie des protarses femelle est le plus surprenant. Non moins étonnante est la présence de sillons métasternaux latéraux semblables à ceux des Ptomaphagini et de certains Nemadini. Ce genre présente donc des caractères intermédiaires entre les Ptomaphagini, les Nemadini, et les Leptodirini. Plus précisément, *Sciaphyes* partage avec les Leptodirini la séparation des cavités mésocoxales et métacoxales, la forme du spiculum ventrale, la conformation de l'édéage, et les caractères régressifs habituels de l'habitat souterrain: réduction oculaire, réduction de la carène frontale, dépigmentation. Il partage avec les Ptomaphagini la séparation des cavités mésocoxales par une nette carène mésosternale, la présence des sillons métasternaux latéraux, et la présence d'une rangée d'épines subégales sur le bord de la troncature apicale des tibias intermédiaires et postérieurs. Il partage avec les Nemadini la spermathèque primitive non sclérifiée, et avec certaines espèces seulement de Nemadini les carènes métasternaux latéraux.

Nous continuons ici à considérer *Sciaphyes* comme un Leptodirini, en raison principalement de la séparation des hanches postérieures. Cette spécificité constitue donc seul caractère qui permet de définir strictement les Leptodirini. Tous les autres caractères invoqués par le passé comportent des exceptions, en particulier la spermathèque sclérifiée aux deux extrémités (CERRUTI, 1958, PERREAU, 1989) et la réduction du nombre des protarsomères de 5 à 4 chez la femelle. Ce dernier caractère ne garantissait d'ailleurs pas le caractère monophylétique du groupe puisque des réductions plus ou moins prononcées du nombre des tarsomères se rencontrent dans d'autres sous-familles de Leiodidae. Mais la séparation des hanches postérieures ne peut pas non plus être considérée à priori comme un caractère apomorphe. En effet, au sein des Leiodidae, la tendance pour les cavités coxales est de migrer depuis la périphérie du corps vers le centre. L'insertion centrale des appendices, combinée à l'allongement de ceux-ci est en effet le meilleur compromis entre l'agilité (la mobilité) et la stabilité. Dans ce cadre, des cavités mésocoxales et/ou métacoxales distantes doivent être considérées comme plésiomorphes par rapport à des cavités coxales confluentes.

La conséquence est que suivant cette interprétation, les Leptodirini ainsi définis doivent être considérés comme un groupe non monophylétique. A l'inverse l'ensemble des Anemadini (Nemadina, Eocatopina, Paracatopina et Anemadina) plus les Cholevini (Catopina et Cholevina) dont les cavités coxales intermédiaires et postérieures sont confluentes doit alors être considéré comme monophylétique.

***Sciaphyes kurbatovi* n. sp.**

Holotype ♂: S. Primorje, réserve de Kedrovaya pad. 1.VIII.1987, leg. S. Kurbatov (MHNG). Paratype 1 ♀, S. Primorje, E Ussurijsk environ de Kamenushka. 7.VII.1987, leg. S. Kurbatov (MHNG).

Description: En plus des caractères génériques, on peut signaler les points suivants:

Longueur: 1,38 mm. Microréticulation du pronotum et de la tête forte et uniforme, nettement orientée transversalement malgré l'absence de stries. Celle de la tête reste néanmoins moins forte que celle du pronotum.

Stries élytrales au nombre d'une quarantaine sur la longueur d'un élytre qui mesure 1 mm.

Carène mésosternale basse mais comportant un angle obtus (figure 14). Carène abdominale représentée sur la figure 13. Segment IX représenté sur la figure 11.

Tarses antérieurs bien dilatés, un peu plus larges que la largeur des tibias. Tarses intermédiaires non dilatés.

Édage allongé, à paramères larges dans la moitié basale, plus étroits dans la moitié apicale, le plateau apical muni de deux soies fines dorsales, deux soies fines ventrales au centre, deux fortes soies ventrales internes et d'une soie très épaisse ventrale externe non amincie à l'extrémité, courbée vers l'arrière (figures 7 et 10).

Femelle semblable au mâle exceptée la dilatation des tarses antérieurs. Tarses antérieurs de 5 articles (figure 9). Ventrite VIII et spiculum ventrale représentés sur la figure 12.

Cette espèce se distingue facilement du *Sciaphyes sibiricus* par l'édage régulièrement rétréci puis arrondi à l'apex, et non pas effilé en pointe.

Sciaphyes sp.

Une autre espèce probablement nouvelle n'est connue que par une ♀: S. Primorje 25 km NW Terney, sapin pourri, 3.VII.1992, leg. S. Kurbatov (MHNG). Nous attendons d'être en possession d'un mâle pour procéder à sa description formelle.

Un peu plus petite que l'espèce précédente (1,28 mm), elle s'en distingue par la tête pratiquement lisse, avec seulement les quelques points très fins correspondant à l'insertion des soies, une microréticulation faible, et une ponctuation très délicate sur le pronotum dont la surface discale est presque lisse.

Les stries élytrales sont au nombre de moins d'une trentaine sur la longueur d'un élytre qui mesure 0,715 mm. On peut remarquer que le nombre de stries par unité de longueur est le même que chez l'espèce précédente, alors que les longueurs des élytres sont sensiblement différentes.

Une investigation pourrait être intéressante à réaliser dans d'autres genres de Cholevinae, pour déterminer si le nombre de stries est un caractère spécifique donné ou s'il dépend de la taille. L'observation ci-dessus soutient la seconde hypothèse.

La carène abdominale est représentée en vue latérale sur la figure 16, et la spermathèque sur la figure 15.

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